NASA/SP—1998–7037/SUPPL380
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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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Typical Report Citation and Abstract

❶ **19970001126** NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10’ to 50’, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65’ swept forebody serrations tended to roll together, while vortices from 40’ swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

Key

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2. Title
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4. Publication Date
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7. Abstract
8. Abstract Author
9. Subject Terms

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 380)

AUGUST 7, 1998

01
AERONAUTICS

19980197302 Logistics Management Inst., McLean, VA USA
Aircraft/Air Traffic Management Functional Analysis Model: Technical Description, 2.0 ***Final Report***
Etheridge, Melvin, Logistics Management Inst., USA; Plugge, Joana, Logistics Management Inst., USA; Retina, Nusrat, Logistics Management Inst., USA; Apr. 1998; 72p; In English
Contract(s)/Grant(s): NAS2-14361; RTOP 538-04-14-02
Report No.(s): NASA/CR-1998-207657; NAS 1.26:207657; LMI-NS703S2; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Aircraft/Air Traffic Management Functional Analysis Model, Version 2.0 (FAM 2.0), is a discrete event simulation model designed to support analysis of alternative concepts in air traffic management and control. FAM 2.0 was developed by the Logistics Management Institute (LMI) under a National Aeronautics and Space Administration (NASA) contract. This document provides a technical description of FAM 2.0 and its computer files to enable the modeler and programmer to make enhancements or modifications to the model. Those interested in a guide for using the model in analysis should consult the companion document, Aircraft/Air Traffic Management Functional Analysis Model, Version 2.0 Users Manual.
Author (revised)
Air Traffic; Logistics Management; Functional Analysis; Air Traffic Control; Airports; Air Transportation

19980197317 Logistics Management Inst., McLean, VA USA
Aircraft/Air Traffic Management Functional Analysis Model, Version 2.0, User's Guide ***Final Report***
Etheridge, Melvin, Logistics Management Inst., USA; Plugge, Joana, Logistics Management Inst., USA; Retina, Nusrat, Logistics Management Inst., USA; Apr. 1998; 44p; In English
Contract(s)/Grant(s): NAS2-14361; RTOP 538-04-14-02
Report No.(s): NASA/CR-1998-207658; NAS 1.26:207658; LMI-NS703S1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Aircraft/Air Traffic Management Functional Analysis Model, Version 2.0 (FAM 2.0), is a discrete event simulation model designed to support analysis of alternative concepts in air traffic management and control. FAM 2.0 was developed by the Logistics Management Institute (LMI) a National Aeronautics and Space Administration (NASA) contract. This document provides a guide for using the model in analysis. Those interested in making enhancements or modification to the model should consult the companion document, Aircraft/Air Traffic Management Functional Analysis Model, Version 2.0 Technical Description.
Author (revised)
Air Traffic; Air Traffic Control; Management Analysis; Air Transportation

19980197322 Logistics Management Inst., McLean, VA USA
The ASAC Air Carrier Investment Model (Third Generation) ***Final Report***
Wingrove, Earl R., III, Logistics Management Inst., USA; Gaier, Eric M., Logistics Management Inst., USA; Santmire, Tara E., Logistics Management Inst., USA; Apr. 1998; 64p; In English
Contract(s)/Grant(s): NAS2-14361; RTOP 538-04-14-02
Report No.(s): NASA/CR-1998-207656; NAS 1.26:207656; LMI-NS702S1; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

To meet its objective of assisting the U.S. aviation industry with the technological challenges of the future, NASA must identify research areas that have the greatest potential for improving the operation of the air transportation system. to accomplish this,

NASA is building an Aviation System Analysis Capability (ASAC). The ASAC differs from previous NASA modeling efforts in that the economic behavior of buyers and sellers in the air transportation and aviation industries is central to its conception. to link the economics of flight with the technology of flight, ASAC requires a parametrically based model with extensions that link airline operations and investments in aircraft with aircraft characteristics. This model also must provide a mechanism for incorporating air travel demand and profitability factors into the airlines' investment decisions. Finally, the model must be flexible and capable of being incorporated into a wide-ranging suite of economic and technical models flat are envisioned for ASAC.
Author
Commercial Aircraft; Air Transportation; Airline Operations; Aircraft Industry; Civil Aviation

19980201252 Analytical Services and Materials, Inc., Hampton, VA USA
Structural Integrity Analysis and Verification of Aircraft Structures ***Final Report, Jul. - Oct. 1995***
Krishnan, S., Analytical Services and Materials, Inc., USA; Boyd, K. L., Analytical Services and Materials, Inc., USA; Harter, J. A., Analytical Services and Materials, Inc., USA; Mar. 1997; 52p; In English
Contract(s)/Grant(s): F33615-94-D-3212; AF Proj. 2401
Report No.(s): AD-A338473; WL-TR-97-3053; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

AFGROW is a workstation-based, graphically interactive computer program for simulation of fatigue crack growth in various structural geometries subject to spectral loading. It is a highly flexible code utilizing standard user-interface objects such as push-buttons and menus, to create a simple and intuitive environment for the fracture mechanics analyst. The program insulates the user from the complexities of data files and their formats by performing all file creation, retrieval an management tasks. AFGROW is a direct descendent of the computer co de, MODGRO, with many changes and new capabilities completely rewritten in C computer language. AEGROW takes the best features of its predecessors and combines them with new ideas into a single, manageable code. Some of the more useful features of AFGROW include the ability to use a material database library for crack growth rate and mechanical property data, an option to approximate stress intensity factor solutions for arbitrary stress fields, and the ability to import stress spectra of virtually any size. This manual describes the features and capabilities of AFGROW and the use of the Graphical User Interface (GUl) to define problems and perform analyses. The various files used in AFGROW, their naming conventions and file formats are presented. The user-interface, with all menu options and dialogs, is included, as well as instructions on obtaining AFGRO via anonymous File Transfer Protocol (FTP). The tutorial describes the steps involved in setting up and analyzing an example problem.
DTIC
Computer Programs; Stress Intensity Factors; Aerospace Vehicles; Structural Failure; Computerized Simulation; Aircraft Structures

19980201375 General Accounting Office, Washington, DC USA
F-22 Aircraft Progress in Achieving Engineering and Manufacturing Development Goals
Mar. 10, 1998; 34p; In English
Report No.(s): AD-A339197; GAO/NSIAD-98-67; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

As required by the National Defense Authorization Act for Fiscal Year 1998, we reviewed the Air Force's F-22 engineering and manufacturing development (EMD) program. This report presents our conclusions regarding whether the EMD program is likely to be completed at a total cost that does not exceed the cost limitation established in the act. The report also discusses the extent to which the cost, schedule, and performance goals for the F-22 EMD program are being met and identifies contract modifications expected to have a significant effect on cost or performance of F-22 aircraft. The act requires us to certify whether we had access to sufficient information to make judgments on the matters covered by this report.
DTIC
F-22 Aircraft; Cost Estimates; Congressional Reports; Product Development; Jet Aircraft; Fighter Aircraft; Procurement Management

19980201381 General Accounting Office, National Security and International Affairs Div., Washington, DC USA
Navy Aviation: F/A-18E/F Development and Production Issues
Mar. 18, 1998; 39p; In English
Report No.(s): AD-A340041; GAO/NSIAD-98-61; B-277801; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The F/A-18E/F is currently undergoing development flight testing as part of its engineering and manufacturing development (EMD) phase of the acquisition cycle. The development flight test program is under the responsibility of the integrated Test Team, which consists of Navy and contractor personnel. The team also receives support from the Navy's Operational Test and Evaluation Force. The F/A-18E/F development flight test program began in February 1996 at the Naval Air Warfare Center, Pattixent River

Naval Air Station, Lexington Park, Maryland. The integrated Test Team is using the seven test aircraft provided by Boeing (formerly McDonnell Douglas) under the EMD contract. The seven aircraft consist of five single-seat E models and two 2-seat F models. Boeing has also built 3 ground test article aircraft to use in conducting tests at its St. Louis, Missouri, facility, and General Electric Corporation, Lynn, Massachusetts, has delivered 21 engines for flight testing.
DTIC
Ground Tests; Flight Tests

19980201410 Logistics Management Inst., McLean, VA USA
Key Metrics and Goals for NASA's Advanced Air Transportation Technologies Program ***Final Report***
Kaplan, Bruce, Logistics Management Inst., USA; Lee, David, Logistics Management Inst., USA; May 1998; 44p; In English
Contract(s)/Grant(s): NAS2-14361; RTOP 538-08-11-01
Report No.(s): NASA/CR-1998-207678; NAS 1.26:207678; LMI-NS709S1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

NASA's Advanced Air Transportation Technologies (AATT) program is developing a set of decision support tools to aid air traffic service providers, pilots, and airline operations centers in improving operations of the National Airspace System (NAS). NASA needs a set of unifying metrics to tie these efforts together, which it can use to track the progress of the AATT program and communicate program objectives and status within NASA and to stakeholders in the NAS. This report documents the results of our efforts and the four unifying metrics we recommend for the AATT program. They are: airport peak capacity, on-route sector capacity, block time and fuel, and free flight-enabling.
Author
Air Transportation; Airline Operations; National Airspace System; Air Traffic

19980201593 Department of the Air Force, Washington, DC USA
Designating and Naming Defense Military Aerospace Vehicles
Sep. 01, 1997; 23p; In English
Report No.(s): AD-A339210; AFJI-16-401; AR-70-50; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This joint service publication implements DoD Directive 4120.15, 'Designating and Naming Military Aerospace Vehicles', May 2, 1985. It provides guidance and procedures for designating and naming defense military aerospace vehicles. The Air Force will use this instruction with AFPD 16-4, 'Accounting for Units, Installations, and Aerospace Vehicles'. A glossary of references and supporting information is at Attachment 1.
DTIC
Aerospace Vehicles; Procedures; Military Technology

02
AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

19980197487 Naval Surface Warfare Center, Dahlgren, VA USA
The 1998 Version of the NSWC Aeroprediction Code, Part 1, Summary of New Theoretical Methodology
Moore, F. G., Naval Surface Warfare Center, USA; McInville, R. M., Naval Surface Warfare Center, USA; Hymer, T., Naval Surface Warfare Center, USA; Apr. 1998; 129p; In English
Report No.(s): AD-A342842; NSWCDD/TR-98/1; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The NSWC Aero prediction code has been extended to the roll position of 45 deg (fins in 'x' or cross roll orientation) in addition to the roll position of 0 deg (fins in '+' or plus roll orientation). It has also been extended to compute aerodynamics of nonaxisymmetric bodies based on an equivalent axisymmetric body. In addition, the nonlinear aerodynamic loads have been distributed over the body and lifting surfaces to provide a more useful tool for preliminary structural analysis. Finally, new technology was developed to improve the prediction of axial force at angle of attack (AOA). These new technologies have been integrated into the AP95 and will be transitioned to legitimate users as the AP98. to make the AP98 more user friendly, an upgraded pre- and post-processing, personal computer interface was also developed. Comparisons of the new theory have been made to both experimental data and the AP95. Comparisons of theory and experiment show the AP98 to be at least as good as the AP95 and, in general, maybe slightly better. In general, average accuracy levels of aerodynamics are +/- 10 percent on axial and normal force and +/- 4 percent of body length on center of pressure. For nonaxisymmetric body cases, accuracy can be slightly higher than these numbers, although not enough cases have been considered to make a definitive assessment. While these accuracy levels are encourag-

ing for a semiempirical code, they could be improved upon by use of computational fluid dynamics codes or additional experimental data or both to reduce errors due to limited data bases.
DTIC
Computer Programs; Aerodynamic Loads; Computational Fluid Dynamics; Data Bases; Structural Analysis

19980200976 NASA Ames Research Center, Moffett Field, CA USA
Experimental Study of Saddle Point of Attachment in Laminar Juncture Flow
Coon, Michael D., NASA Ames Research Center, USA; Tobak, Murray, NASA Ames Research Center, USA; AIAA Journal; Dec. 1995; Volume 33, No. 12, pp. 2288-2292; In English; 33rd; AIAA Aerospace Sciences Meeting, 9-12 Jan. 1995, Reno, NV, USA
Report No.(s): NASA/TM-95-207302; NAS 1.15:207302; AIAA Paper 95-0785; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

An experimental study of laminar horseshoe vortex flows upstream of a cylinder/flat plate juncture has been conducted to verify the existence of saddle-point-of-attachment topologies. In the classical depiction of this flowfield, a saddle point of separation exists on the flat plate upstream of the cylinder, and the boundary layer separates from the surface. Recent computations have indicated that the topology may actually involve a saddle point of attachment on the surface and additional singular points in the flow. Laser light sheet flow visualizations have been performed on the symmetry plane and crossflow planes to identify the saddle-point-of-attachment flowfields. The visualizations reveal that saddle-point-of-attachment topologies occur over a range of Reynolds numbers in both single and multiple vortex regimes. An analysis of the flow topologies is presented that describes the existence and evolution of the singular points in the flowfield.
Author
Flow Visualization; Horseshoe Vortices; Flow Characteristics; Saddle Points; Boundary Layer Separation; Boundary Layer Transition; Reattached Flow; Reynolds Number; Flow Distribution

19980201099 NASA Lewis Research Center, Cleveland, OH USA
Flowfield Measurements in a Slot-Bled Oblique Shock Wave and Turbulent Boundary-Layer Interaction
Davis, D. O., NASA Lewis Research Center, USA; Willis, B. P., NASA Lewis Research Center, USA; Hingst, W. R., NASA Lewis Research Center, USA; Apr. 1998; 14p; In English; 33rd; Aerospace Sciences Meeting and Exhibit, 9-12 Jan. 1995, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Contract(s)/Grant(s): RTOP 505-62-52
Report No.(s): NASA/TM-1998-206974; E-11126; NAS 1.15:206974; AIAA Paper 95-0032; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An experimental investigation was conducted to determine the flowfield inside a bleed slot used to control an oblique shock-wave and turbulent boundary-layer interaction. The slot was oriented normal to the primary flow direction and had a width of 1.0 cm (primary flow direction), a length of 2.54 cm, and spanned 16.5 cm. The approach boundary layer upstream of the interaction was nominally 3.0 cm thick. Two operating conditions were studied: M = 1.98 with a shock generator deflection angle of 6 deg and M= 2.46 with a shock generator deflection angle of 8 deg. Measurements include surface and flowfield static pressure, Pitot pressure, and total mass-flow through the slot. The results show that despite an initially two-dimensional interaction for the zero bleed-flow case, the slot does not remove mass uniformly in the spanwise direction. Inside the slot, the flow is characterized by two separation regions which significantly reduce the effective flow area. The upper separation region acts as an aerodynamic throat resulting in supersonic flow through much of the slot.
Author
Flow Measurement; Oblique Shock Waves; Boundary Layer Control; Boundary Layer Transition; Turbulent Boundary Layer; Shock Wave Interaction; Interactional Aerodynamics; Slots; Mass Flow

19980201245 NASA Dryden Flight Research Center, Edwards, CA USA
Reynolds Number Effects at High Angles of Attack
Fisher, David F., NASA Dryden Flight Research Center, USA; Cobleigh, Brent R., NASA Dryden Flight Research Center, USA; Banks, Daniel W., NASA Dryden Flight Research Center, USA; Hall, Robert M., NASA Langley Research Center, USA; Wahls, Richard A., NASA Langley Research Center, USA; Jun. 1998; 32p; In English; 20th; Advanced Measurement and Ground Testing Technology, 15-18 Jun. 1998, Albuquerque, NM, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 529-50-04-00-RR
Report No.(s): NASA/TP-1998-206553; H-2255; NAS 1.60:206553; AIAA Paper 98-2879; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Lessons learned from comparisons between ground-based tests and flight measurements for the high-angle-of-attack programs on the F-18 High Alpha Research Vehicle (HARV), the X-29 forward-swept wing aircraft, and the X-31 enhanced fighter maneuverability aircraft are presented. On all three vehicles, Reynolds number effects were evident on the forebodies at high angles of attack. The correlation between flight and wind tunnel forebody pressure distributions for the F-18 HARV were improved by using twin longitudinal grit strips on the forebody of the wind-tunnel model. Pressure distributions obtained on the X-29 wind-tunnel model at flight Reynolds numbers showed excellent correlation with the flight data up to alpha = 50 deg. Above (alpha = 50 deg. the pressure distributions for both flight and wind tunnel became asymmetric and showed poorer agreement, possibly because of the different surface finish of the model and aircraft. The detrimental effect of a very sharp nose apex was demonstrated on the X-31 aircraft. Grit strips on the forebody of the X-31 reduced the randomness but increased the magnitude of the asymmetry. Nose strakes were required to reduce the forebody yawing moment asymmetries and the grit strips on the flight test noseboom improved the aircraft handling qualities.
Author
Angle of Attack; Fighter Aircraft; X-31 Aircraft; X-29 Aircraft; Reynolds Number; Research Vehicles; In-Flight Monitoring

19980201248 NASA Marshall Space Flight Center, Huntsville, AL USA
Application of Rapid Prototyping Methods to High-Speed Wind Tunnel Testing ***Final Report***
Springer, A. M., NASA Marshall Space Flight Center, USA; May 1998; 60p; In English
Contract(s)/Grant(s): Proj. 96-21
Report No.(s): NASA/TP-1998-208396; M-870; NAS 1.60:208396; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This study was undertaken in MSFC's 14-Inch Trisonic Wind Tunnel to determine if rapid prototyping methods could be used in the design and manufacturing of high speed wind tunnel models in direct testing applications, and if these methods would reduce model design/fabrication time and cost while providing models of high enough fidelity to provide adequate aerodynamic data, and of sufficient strength to survive the test environment. Rapid prototyping methods utilized to construct wind tunnel models in a wing-body-tail configuration were: fused deposition method using both ABS plastic and PEEK as building materials, stereolithography using the photopolymer SL-5170, selective laser sintering using glass reinforced nylon, and laminated object manufacturing using plastic reinforced with glass and 'paper'. This study revealed good agreement between the SLA model, the metal model with an FDM-ABS nose, an SLA nose, and the metal model for most operating conditions, while the FDM-ABS data diverged at higher loading conditions. Data from the initial SLS model showed poor agreement due to problems in post-processing, resulting in a different configuration. A second SLS model was tested and showed relatively good agreement. It can be concluded that rapid prototyping models show promise in preliminary aerodynamic development studies at subsonic, transonic, and supersonic speeds.
Author
Hypersonic Wind Tunnels; Wind Tunnel Tests; Supersonic Wind Tunnels; Laminates; Body-Wing and Tail Configurations; Nylon (Trademark); Photopolymers

19980201442 Boston Univ., Coll. of Engineering, Boston, MA USA
Reference Manual on the Theory of Lifting Surface Noise at Low Mach Numbers ***Final Report, 1 Jul. - 31 Dec. 1997***
Howe, Michael S., Boston Univ., USA; Jan. 09, 1998; 98p; In English
Contract(s)/Grant(s): N00014-97-1-0963
Report No.(s): AD-A338190; AM-98-001; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

A summary review is made of the theory of aerodynamic sound in low Mach number flows, with particular emphasis on procedures for estimating the influence of solid boundaries on sound production. Special consideration is given to the production of sound by nominally steady flow over a lifting or control surface. Four categories of interactions are discussed involving: (1) a large, nominally flat surface, (2) a large surface with a trailing edge, (3) a lifting surface of compact chord and finite span, and (4) a trailing edge with a streamwise slot or part-span flap. The results can be combined with steady state numerical predictions to express the radiation in terms of calculated mean flow properties.
DTIC
Aerodynamic Noise; Lifting Bodies; Mach Number; Low Speed

19980201482 North Carolina Agricultural and Technical State Univ., College of Engineering, Greensboro, NC USA
Numerical Simulations of Wing-Body Junction Flows
Krishnamurthy, R., North Carolina Agricultural and Technical State Univ., USA; Cagle, Corey D., North Carolina Agricultural and Technical State Univ., USA; Chandra, S., North Carolina Agricultural and Technical State Univ., USA; HBCUs Research

Conference Agenda and Abstracts; Apr. 1998, pp. 32; In English; Also announced as 19980201458; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche; Abstract Only; Abstract Only

The total goal of the research project is to contribute to the optimized design of fan bypass systems in advanced turbofan engines such as the Advanced Ducted Propulsors (ADP). The immediate objective is to perform numerical simulation of duct-strut interactions to elucidate the loss mechanisms associated with this configuration that is characteristic of ADP. As the first step in the process, a numerical study of wing-body junction flow is being undertaken as it shares a number of characteristics with the duct-strut interaction flow. Also, the flow in a duct-strut configuration essentially involves the interaction between two wing-body junction type of flows. The experimental data from Kubendran et al. have been used for comparison. The code NPARC (version 2.2) is used for numerical simulations. A three block structured grid used for the simulation has been generated using a multisurface algorithm. All the reported simulations have been performed on the CRAY C90 at the Numerical Aerospace Simulation (NAS) facility at NASA Ames Research Center. The results obtained so far indicate reasonable agreement with the mean flow profiles upstream of the wing-body junction. However, the predicted turbulence kinetic energy profiles show deviation from the measurements in the regions far from the wall. The peak value of the measured turbulence kinetic energy is accurately captured by the computations. So far, a two-equation (k-epsilon) turbulence model has been used to obtain converged results. Efforts are underway to explore the efficacy of other turbulence models such as k-omega which is expected to perform better in predicting such separated, turbulent boundary layers as considered here.

Author

Body-Wing Configurations; K-Epsilon Turbulence Model; Structured Grids (Mathematics); Ducts; Struts; Flow Characteristics; Turbulent Flow; Computerized Simulation; Configuration Interaction

19980201566 Texas Univ., Dept. of Aerospace Engineering and Engineering Mechanics, Austin, TX USA

An Experimental Study of Passive Control of Hypersonic Cavity Flow Oscillations ***Final Report, 1 Oct. 1994 - 30 Sep. 1997***

Dolling, D. S., Texas Univ., USA; Perng, S. W., Texas Univ., USA; Leu, Y. L., Texas Univ., USA; Mar. 01, 1998; 140p; In English

Contract(s)/Grant(s): F49620-95-1-0001

Report No.(s): AD-A339335; AFRL-SR-BL-TR-98-0240; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

An experimental study of open cavity flow has been made in a high Reynolds number, Mach 5 turbulent boundary layer. The majority of measurements made were of fluctuating wall pressures. The objectives were: (1) examine how effective changes in front and rear wall geometry were at attenuating the pressure oscillations, (2) explore how impingement of a shock wave (variable strength and position) the cavity flow, and (3) how stores (different geometries and positions) affected the cavity flow. In addition, techniques which were judged effective at attenuating pressure oscillations for the empty cavity were used with shock impingement and with stores in order to explore their effectiveness under perturbed flow conditions. The results show that vented and slotted walls, and spoilers are ineffective. A 3-D rear wall (swept in both planes and symmetric about the center line) attenuated the strongest oscillations by factors of up to 7 compared to the baseline rectangular cavity. Regardless of shock impingement position, shock strength, store position, store dimensions, store to cavity volume ratio and asymmetric store arrangement the cavity oscillation frequencies remain essentially unchanged. Based on the mean and rms Pressure distributions (whose magnitude varies substantially but whose basic shape does not change significantly) and surface flow patterns it appears that the essential flow structure also remains largely unchanged. These similarities suggest that control techniques developed for the empty cavity flow should be effective with shock impingement or store release. Tests using two passive control rear walls in perturbed cavity flow support this conclusion.

DTIC

Turbulent Boundary Layer; High Reynolds Number; Hypersonic Flow

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

19980197296 Adsystech, Inc., Hampton, VA USA

Air Traffic and Operational Data on Selected US Airports with Parallel Runways

Doyle, Thomas M., Adsystech, Inc., USA; McGee, Frank G., Lockheed Martin Engineering and Sciences Co., USA; May 1998; 58p; In English

Contract(s)/Grant(s): NAS1-96014; DTFA01-97-C-00057; RTOP 538-04-11-17

Report No.(s): NASA/CR-1998-207675; NAS 1.26:207675; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report presents information on a number of airports in the country with parallel runways and focuses on those that have at least one pair of parallel runways closer than 4300 ft. Information contained in the report describes the airport's current operational activity as obtained through contact with the facility and from FAA air traffic tower activity data for FY 1997. The primary reason for this document is to provide a single source of information for research to determine airports where Airborne Information for Lateral Spacing (AILS) technology may be applicable.
Author
Airports; Runways; Air Traffic Control; Flight Paths; Airline Operations

19980197320 NASA Ames Research Center, Moffett Field, CA USA
An Evaluation and Redesign of the Conflict Prediction and Trial Planning Planview Graphical User Interface
Laudeman, Irene V., NASA Ames Research Center, USA; Brasil, Connie L., San Jose State Univ., USA; Stassart, Philippe, Sterling Software, Inc., USA; Apr. 1998; 21p; In English; Original contains color illustrations
Contract(s)/Grant(s): RTOP 538-18-22
Report No.(s): NASA/TM-1998-112227; A-98-10366A; NAS 1.25:112227; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Planview Graphical User Interface (PGUI) is the primary display of air traffic for the Conflict Prediction and Trial Planning, function of the Center TRACON Automation System. The PGUI displays air traffic information that assists the user in making decisions related to conflict detection, conflict resolution, and traffic flow management. The intent of this document is to outline the human factors issues related to the design of the conflict prediction and trial planning portions of the PGUI, document all human factors related design changes made to the PGUI from December 1996 to September 1997, and outline future plans for the ongoing PGUI design.
Author
Air Traffic; Air Traffic Control; Display Devices; Graphical User Interface; Human Factors Engineering

19980197489 Federal Aviation Administration, Washington, DC USA
Evaluation of Improved Restraint Systems for Sport Parachutists
Gowdy, R. V., Federal Aviation Administration, USA; DeWeese, R., Federal Aviation Administration, USA; Mar. 1998; 24p; In English
Report No.(s): AD-A342643; DOT/FAA/AM-98/11; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

part of a cooperative project between the Federal Aviation Administration's Civil Aeromedical Institute, the Parachute Industries Association, and the USA Parachute Association, a series of dynamic impact sled tests were performed to evaluate new types of restraint systems for sport parachutists. The traditional means of restraining sport parachutists sitting aft-facing on the floor has been to provide lap belts that are attached to the floor or sidewall of the airplane. The restraint systems evaluated in this project were designed to route through the parachute harness and attach to the floor. Thus, occupant restraint was provided by anchoring the parachute harness to the floor by means of the new restraint devices. Seven methods of attaching the restraints to the parachute harness, which included both single and dual point restraint systems, were dynamically tested.
DTIC
Dynamic Tests; Aerospace Medicine; Parachute Descent; Impact Tests; Harnesses; Constraints; Anchors (Fasteners)

19980200801 Air Force Flight Test Center, Edwards AFB, CA USA
An Investigation of Three Probe-and-Drogue Aerial Refueling Tasks to Evaluate Closed-Loop Handling Qualities (HAVE GAS 2) ***Final Report, 17-22 Apr. 1997***
Latimer, Kelly J., Air Force Flight Test Center, USA; sizoo, David G., Air Force Flight Test Center, USA; O'connor, Stephen D., Air Force Flight Test Center, USA; Blatt, Nicole I., Air Force Flight Test Center, USA; Nelson, Christopher J., Air Force Flight Test Center, USA; Nov. 1997; 93p; In English
Contract(s)/Grant(s): PEC-65807F
Report No.(s): AD-A341972; AFFTC-TR-97-13; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report presents the results of a limited investigation of three probe and drogue aerial refueling tasks to evaluate longitudinal closed loop handling qualities (HAVE GAS 2) flight test program. The objective was to identify the best of three tasks for evaluating closed-loop probe and drogue aerial refueling (AR) handling qualities. Testing was conducted at Edwards AFB, California, from 17 to 22 April 1997. Three tasks, an AR hookup, a drogue tracking, and a drogue aiming task were evaluated and compared in this test program. These tasks were performed with two different aircraft, the F/A-18B and the NT-33-A. Tanker

support was provided by S-3B aircraft from North Island NAS, California. The results of this test will be used to develop an closed-loop, probe and drogue demonstration maneuver for MIL-STD-1797A, Flying Qualities of Piloted Aircraft.
DTIC
Air to Air Refueling; Feedback Control; Flight Tests

19980201054 National Transportation Safety Board, Washington, DC USA
National Transportation Safety Board Transportation Initial Decisions and Orders and Board Opinions and Orders Adopted and Issued during the Month of March, 1998
Mar. 1998; 458p; In English
Report No.(s): PB98-916703; NTSB/IDB00-98/03; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche
This publication contains all Judge Initial Decisions and Board Opinions and Order in Safety Enforcement and Seaman Enforcement Cases for March 1998.
NTIS
Safety Management; Air Transportation

19980201369 Defence and Civil Inst. of Environmental Medicine, Downsview, Ontario Canada
A Review of Push-pull Effect in Canadian Forces Aircraft Accidents: 1976-1995
Brush, Michael L., Defence and Civil Inst. of Environmental Medicine, Canada; Nov. 27, 1997; 10p; In English, USA
Report No.(s): AD-A339131; DCIEM-98-TM-06; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Push-pull effect has been defined as decreased +Gz tolerance resulting from preceding relative -Gz. It has been identified in laboratory and in-flight studies, but little is known about the operational incidence of push-pull effect within the Canadian Forces (CF). In order to enhance our knowledge, a review of CF Boards of Inquiry (BOIs), Aircraft Accident Incident Reports (AAIR) and Flight Safety Summary Investigations (FSII) was initiated to determine if push-pull effect was causal in any previous aircraft accidents. A total of 284 CF jet and trainer accidents were reviewed of which 95 were 'A' category. Eighteen were selected for detailed review (all 'A' category), from which five accidents were identified as involving, or possibly involving, push-pull effect. The results of this study suggest that push-pull effect was a probable or possible cause factor in at least five CF aircraft accidents and two CF aircraft incidents over 20 years from 1976 to 1996. Research into methods to protect against the push-pull effect is continuing at DCIEM. This report is being circulated in accordance with a recommendation from the accident that occurred in July 1995 in Cold Lake, which was to promote education of the CF Fighter community on the hazards and insidious nature of the push-pull effect. The results of this study should be made widely available in order to continue that effort.
DTIC
Acceleration Tolerance; Aircraft Accident Investigation; Flight Safety; Aircraft Accidents; Push-Pull Amplifiers

19980201378 General Accounting Office, National Security and International Affairs Div., Washington, DC USA
Military Aircraft Safety; Serious Accidents Remain at Historically Low Levels
Mar. 1998; 12p; In English
Report No.(s): AD-A339740; GAO/NSIAD-98-95BR; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Flight mishaps involve any reportable damage to an aircraft that is prevailing to fly, in flight, or completing a landing. Flight mishaps are classified by DOD according to the severity of resulting injury or property damage. Class A mishaps involve damage of $1 million or more, a destroyed aircraft, or a fatality or permanent total disability. The remaining classes of mishaps are distinguished primarily by their loss value and severity of injury: Class B accidents involve damage ranging from $200,000 to less than $1 million, permanent partial disability, or inpatient hospitalization of five or more people; Class C accidents involve damage ranging from $10,000 to less than $200,000 or a lost-time injury; and Class D accidents involve damage of less than $10,000. Our review focused on Class A flight mishaps only. DOD requires that all mishaps be investigated so that causes can be identified and corrective actions taken to prevent future occurrences. Service safety centers play a key role in maintaining aviation mishap statistics, establishing safety policies, disseminating safety information, reviewing mishap investigation reports, tracking recommendations, and performing safety studies. In addition, the safety centers analyze trends to identify potential safety hazards. In our 1996 review,2 we reported that DOD aviation safety had improved significantly over the previous two decades. Between fiscal year 1975 and 1995, for example, the annual number of Class A mishaps decreased from 309 to 76, while the number of fatalities decreased from 285 to 85. During this period, Class A mishaps per 100,000 flying hours, referred to as the mishap rate, also

decreased from about 4.3 to 1.5. The value of Class A losses during the early 1990s ranged from a high of about $1.6 billion in fiscal year 1993 to a low of $1.2 billion in fiscal year 1994.
DTIC
Damage Assessment; Flight Safety; Aircraft Safety; Accident Investigation

19980201532 Army Aeromedical Research Lab., Aircrew Protection Div., Fort Rucker, AL USA
Head Injury Risk in U.S. Army Rotary-Wing Mishaps: Changes Since 1980 ***Final Report***
Shannon, Samuel G., Army Aeromedical Research Lab., USA; Albano, John P., Army Aeromedical Research Lab., USA; Mason, Kevin T., Army Aeromedical Research Lab., USA; Licina, Joseph R., Army Aeromedical Research Lab., USA; Jan. 1998; 14p; In English
Contract(s)/Grant(s): 30162787A878
Report No.(s): AD-A339781; USAARL-98-13; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Over the past several decades, data have been collected on U.S. Army aircraft mishaps defining the environment within an aircraft during a mishap, injuries suffered by the occupants, and the cause (or causes) of the mishap, if known. An analysis of these data indicates 60 percent of the occupants are injured, one-third fatally, if the mishap concludes with the aircraft impacting the ground. More significantly, despite improvements in helicopter design, restraint systems, and personal protective equipment, 68 percent of all fatalities had at least one fatal injury to the head. After adjusting for differences in mishaps, including the aircraft series, and the occupant's station within the aircraft, the authors concluded that an occupant's injury risk in a helicopter mishap had decreased significantly between 1980-84 and 1990-94. One factor in this was a decline in the risk of head injury, which declined by 50 percent. Injury risks to the face and brain, critical anatomical regions of the head, also showed a significant decline. Risks of injury to the neck, torso, and upper extremities were not significantly different between the two time intervals. Although the authors could not identify causative factors with clear implications for preventive strategies, the proportion of new, crashworthy helicopters in the U.S. Army fleet have risen steadily since 1980, and a new flyer's helmet with improved impact protection, the SPH-4B, was fielded by the U.S. Army in the 1990s.
DTIC
Rotary Wings; Aircraft Accidents; Crashworthiness; Helmets; Injuries

19980201550 Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA
The Effects of Compression-Induced Distortion of Graphical Weather Images on Pilot Perception, Acceptance, and Performance
Lind, A. T., Massachusetts Inst. of Tech., USA; Dershowitz, A., Massachusetts Inst. of Tech., USA; Chandra, D., Massachusetts Inst. of Tech., USA; Bussolari, S., Massachusetts Inst. of Tech., USA; Nov. 21, 1997; 94p; In English
Contract(s)/Grant(s): F19628-95-C-0002; DTFA01-93-Z-02012
Report No.(s): AD-A340360; ATC-243; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The Graphical Weather Service (GWS) is a data link application that will provide near-real-time graphical weather information to pilots in flight. To assess the effect of GWS. as well as to aid in the proper design, implementation and certification of the use of GWS in aircraft, two human factors studies have been conducted. The second study conducted (Phase Two) is the topic of this report. Phase Two was conducted to determine the maximum level of compression-induced distortion that would be acceptable for transmission of weather images to the cockpit.
DTIC
Human Factors Engineering; Meteorological Services; Real Time Operation; Graphs (Charts); Acceptability

19980201597 Civil Aeromedical Inst., Oklahoma City, OK USA
Performance Demonstrations of Zinc Sulfide and Strontium Aluminate Photoluminescent Floor Proximity Escape Path Marking Systems ***Final Report***
McLean, G. A., Civil Aeromedical Inst., USA; Chittum, C. B., Civil Aeromedical Inst., USA; Feb. 1998; 11p; In English
Report No.(s): AD-A339339; DOT/FAA/AM-98/2; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Transport category aircraft are required by 14 CFR 25.812 to have emergency lighting systems, including floor proximity marking systems. Typical floor proximity marking systems installed on transport category aircraft have been primarily comprised of incandescent luminaries spaced at intervals on the floor, or mounted on the seat assemblies, along the aisle. The requirement for electricity to power these systems has made them vulnerable to a variety of problems, including battery and wiring failures, burned-out light bulbs, and physical disruption caused by vibration, passenger traffic, galley cart strikes, and hull breakage in accidents. Attempts to overcome these problems have led to the proposal that non-electric photoluminescent materials be used in the construction of floor proximity marking systems. to assess the viability of this proposal, performance demonstrations of systems

made with such materials were conducted. It was found that strontium aluminate photoluminescent marking systems can be effective in providing the guidance for egress that floor proximity marking systems are intended to achieve; in contrast, zinc sulfide materials were found to be ineffective.
DTIC
Photoluminescence; Lighting Equipment; Escape Systems; Failure; Emergencies; Marking

19980201661 Technische Univ., Inst. of Flight Guidance and Control, Brunswick, Germany
Conduct of the Aircraft: Flight Dynamics
Schaenzer, G., Technische Univ., Germany; Dec. 1997; 6p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Safety, production and operation costs have an influence on the design of aircraft flight controllers and thus, as well on the necessary sensors and actuators. Reliability and safety have a dominating role in this design process. Taking these premises into consideration, this paper describes some important aircraft flight control design aspects.
Author
Flight Control; Aircraft Control; Control Equipment; Flight Paths; Aircraft Maneuvers

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

19980200921 Defence Science and Technology Organisation, Tactical Surveillance Systems Div., Canberra, Australia
Ionospheric Effects on Global Positioning System Receivers
Knight, Mark F., Defence Science and Technology Organisation, Australia; Finn, Anthony, Defence Science and Technology Organisation, Australia; Cervera, Manuel, Defence Science and Technology Organisation, Australia; Feb. 1998; 105p; In English
Report No.(s): AD-A342594; DSTO-RR-0121; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This report presents the results of a study conducted under tasks ADL 94/373 and ADA 96/005 into the effects of the ionosphere on Global Positioning System (CPS) receivers. The report focuses on the effects of the disturbed ionosphere on GPS as this phenomenon has the capacity to degrade the accuracy and reliability of both civilian and military GPS receivers. The impact of ionospheric disturbances on the susceptibility of GPS in a potentially hostile electromagnetic environment is also discussed.
DTIC
Global Positioning System; Ionospheric Disturbances; Receivers

19980201042 Federal Aviation Administration, William J. Hughes Technical Center, Atlantic City, NJ USA
Operational Test and Evaluation (OT&E) Performance, Integration and Operational Tests of the Mode S Beacon (Enroute Configuration) ***Final Report***
Leone, Andrew, Federal Aviation Administration, USA; Feb. 1998; 127p; In English
Report No.(s): AD-A342060; DOT/FAA/CT-TN97/19; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This document reports the findings of the performance and operational evaluation tests conducted on the Mode Select (Mode S) Beacon System, in a full Mode S mode, enroute configuration collocated with a Common Digitizer Model-2 (CD-2) and Air Route Surveillance Radar (ARSR) system. The tests were conducted at the Federal Aviation Administration (FAA) William J. Hughes Technical Center and at the enroute Mode S keysite located at the St. Albans, Vermont, long range radar facility in conjunction with Boston Air Route Traffic Control Center (ARTCC), located in Nashua, New Hampshire. The Mode S systems under test were fully configured, dual-channel systems having all required external interfaces connected to actual National Airspace System (NAS) equipment, with the exception of the Maintenance Processor Subsystem (MPS), which was not ready for integration with the Mode S at the time of these tests. A combination of system optimization, surveillance performance and operational suitability testing were performed as part of this Operational Test and Evaluation (OT&E) effort. Test goals were to ensure proper operation of the Mode S sensor in Mode S mode of operation for an enroute configuration, while integrated with appropriate NAS equipment. The tests were conducted in accordance with procedures for OT&E stated in FAA Order 1810.4B. The format of this test report is in accordance with FAA-STD-024b.
DTIC
Beacons; Surveillance Radar; Air Traffic Control; Aerial Reconnaissance

19980201086 Civil Aeromedical Inst., Oklahoma City, OK USA

The Relationship of Sector Characteristics to Operational Errors ***Final Report***

Rodgers, Mark D., Civil Aeromedical Inst., USA; Mogford, Richard H., Federal Aviation Administration, USA; Mogford, Leslye S., Rigel Associates, USA; May 1998; 70p; In English

Contract(s)/Grant(s): DTFA02-95-P-35434

Report No.(s): DOT/FAA/AM-98/14; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

An exploratory study was conducted on the relationship of air traffic control (ATC) complexity factors to operational errors (OEs). This consisted of a detailed examination of OE data from 1992 through 1995 from the Atlanta en route center. The Systematic Air Traffic Operations Research Initiative (SATORI) system was used to collect data for the analysis. Sectors were categorized into zero-, low-, and high-error groups. Fifteen sector and traffic flow variables had statistically significant correlations with OE frequency. Four variables were higher for the high-error group as compared to the zero-error group. Sector size was smaller for the high-error group as compared to the combined zero- and low-error categories. A significant multiple correlation was found between overall OE rate and a subset of the ATC complexity measures. The data were also analyzed to define relationships between the complexity measures and controller situational awareness (SA) at the time of the OE. The only statistically significant difference between OEs with and without SA was for horizontal separation. In addition, high-error sectors were characterized by low SA for errors. Certain sector and traffic flow characteristics were associated with these high-error sectors, suggesting that these factors may negatively affect SA. It was concluded that the results demonstrated a relationship between sector complexity and OE rate. Such findings, if extended, could assist with traffic management, sector design activities, and the development of decision-support systems.

Author

Air Traffic Control; Decision Support Systems; Routes; Traffic

19980201303 Federal Aviation Administration, Atlantic City, NJ USA

En Route Generic Airspace Evaluation

Guttman, Jerry A., Federal Aviation Administration, USA; Stein, Earl S., Federal Aviation Administration, USA; Dec. 1997; 64p; In English

Contract(s)/Grant(s): DTFA03-93-C-00032

Report No.(s): AD-A340501; DOT/FAA/CT-TN97/7; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This En Route Generic Airspace Evaluation is one of a series of air traffic control (ATC) simulation experiments. It is directed toward development and validation of the use of generic airspace for use in ATC research and development. For this project, generic refers to a sector that embodies the important elements of an en route sector including airways, en route radar performance, restricted areas, and radar procedures. In a generic sector, conditions are standardized. This is a significant advantage over using each controller's home sector where many factors vary such as familiarity and sector complexity. Experienced Federal Aviation Administration personnel developed and tested this en route generic airspace. The design was based on a typical high-altitude sector used in many en route centers. In addition, the sector was designed to facilitate rapid learning. In this experiment, experienced controllers performed their normal functions working with realistic traffic scenarios presented by a high fidelity ATC simulator. Voice communication equipment enabled controllers to issue commands to remote simulation pilots. The results showed that three performance measurement categories (Air Traffic Workload Input Technique (ATWIT) ratings, system effectiveness measures, and controller self ratings of performance) showed high correlations between the generic and home sectors.

DTIC

Workloads (Psychophysiology); System Effectiveness; Communication Equipment; Air Traffic Control

19980201361 Office of Naval Research, Arlington, VA USA

Information Access of Approach Navigation for Nonlinear Autonomous Systems ***Progress Report, 1, 20 Oct. 1997 - 6 Feb. 1998***

Jawerth, Bjorn, Office of Naval Research, USA; Mar. 04, 1998; 6p; In English

Contract(s)/Grant(s): N00014-97-C-0336

Report No.(s): AD-A339269; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This initial phase of the effort is focused on developing and understanding appropriate definitions, and related tools and methods, applicable to the problem of identifying, classifying, tracking, and acting on visual information, potentially aided by physical information, in highly dynamic environments. We focus on defining elemental aspects of shape, shape evolution, and methods for representing and sampling visual information spaces. Our approach to defining these elemental aspects focuses on identifying computationally efficient methods and to investigating the relationships between elements and objects in the information space. Further we investigate methods that apply a hierarchical segmentation, assignment and processing of information. This process

establishes a foundation for the objectification of the underlying properties in the information space that is consistent with the capabilities provided by the methods and tools identified for extraction, enhancement, or verification of the information properties and objects. Ultimately, this should lead to an information alphabet that allows rapid identification objects within the information environment, as well as providing a method to define many layers of properties which may be assigned to an object. As applied to this project, the alphabet and the associated syntax for building objects will be used to define object in an invariant way, thus leading to a reliable way to gather, fuse, and transmit information sources. This formulation of the information environment will also be applicable to other object related activities, such as, compression, noise reduction, and enhancement, and thus, will provide a computationally efficient foundation for various information processing activities in highly dynamic environments, such as those anticipated for UCAV or hypersonic missile systems.
DTIC
Information Transfer; Nonlinear Systems; Autonomous Navigation; Navigation; Procedures

19980201397 General Accounting Office, Washington, DC USA
AIR TRAFFIC CONTROL: Evoluton and Status of FAA's Automation Program
Mar. 05, 1998; 15p; In English
Report No.(s): AD-A339008; GAO/T-RCED/AIMD-98-85; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
We are pleased to be here today to discuss the air traffic control (ATC) automation program of the Federal Aviation Administration (FAA). Automation and other functional areas such as communications, navigation, and surveillance are the main elements of FAA'S overall plan for modernizing the air traffic control system. The automation program, which began in the early 1980s, involves FAA'S acquisition of modern workstations and computers that process radar and flight data for controllers' use. Because of severe cost, schedule, and technical problems, FAA restructured the automation program in 1994. The Advanced Automation System (AAs) project, divided into 5 separate segments, was the centerpiece of the program before its 1994 restructuring. In 1983, FAA estimated the cost to develop AAS to be $2.5 billion and completion was scheduled for 1996. When International Business Machines (IBM) was awarded a development contract in 1988, after a 4-year design competition, FAA estimated the project would cost $4.8 billion and be completed in 1998. by 1994, when FAA restructured the automation program, FAA estimated the cost to develop AAS to be as much as $7.6 billion with completion as late as 2003.
DTIC
Automatic Control; Controllers; Data Processing; Radar Data; Telecommunication; Air Traffic Control

19980201657 Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine, France
Air Traffic Management: Support for Decision Making Optimisation - Automation ***La Gestion du Traffic Aerien Aide a la Decision Optimisation - Automation***
Benoit, Andre, Editor, European Organization for the Safety of Air Navigation, Belgium; Air Traffic Management: Support for Decision Making Optimization - Automation; Dec. 1997; 284p; In English; The Mission Systems Panel Workshop on ATM, 27-29 May 1997, Budapest, Hungary; Also announced as 19980201658 through 19980201677
Report No.(s): AGARD-R-825; ISBN 92-836-1064-4; Copyright Waived; Avail: CASI; A13, Hardcopy; A03, Microfiche
As a contribution to the increasing cooperation between NATO and former Warsaw Pact countries, the Mission Systems Panel of AGARD organized a Workshop on Air Traffic Management, held in Budapest, Hungary on 27-29 May 1997. Emphasis was placed on the fundamentals of air traffic handling and an effort was made to establish a fruitful dialogue between experienced experts and young mathematicians, physicists and engineers, offering a fresh approach to the on-line conduct of traffic management. The main characteristics of Air Traffic Handling were outlined; it is a large-scale, international, multidisciplinary and complex system. The aircraft, the basic element of air traffic, was given considerable consideration: the manner in which it is flown and its dynamics, the potential role of the on-board flight management system, the current and expected level of automation, and the advent of unmanned military aircraft. Could Air Traffic Handling become a discipline in itself as part of the academic subject of aerospace? What assistance could be made available to the human controller in the present types of operation? Finally, if it was intended to make major improvements to the management of all flights, what optimization techniques were suitable for on-line operations? These important questions were debated in a session devoted to the fundamentals of air traffic management. An attempt was then made to illustrate some trends in the optimization and automation processes: arrivals management in the PHARE programme; application of genetic algorithms to mid-air collision avoidance; the detection and resolution of conflicts using coupled force field techniques and a broad look at global traffic optimization. Plans and prospectives were presented: human-machine interface in the Hungarian MATIAS project; a US view of the situation as seen by the FAA; the CNS/ATM concept as an ICAO prospective and the EATCHIP-EATMS concept offered as a European perspective. The Round Table which ended the meeting offered strong encouragement to the academic and scientific communities to inform their members of the nature, complexity

and interest of the problems - numerous and varied - raised by the need to improve the presently critical air traffic situation. Examples of outstanding doctoral dissertations were included in this Workshop programme.
Author
Flight Management Systems; Air Traffic Control; Flight Plans; Flight Optimization; Automatic Flight Control; Dynamic Control

19980201658 European Organization for the Safety of Air Navigation, EUROCONTROL, Brussels, Belgium
Dynamic Control of Air Traffic: Criteria - Control Variables - Constraints
Benoit, Andre, European Organization for the Safety of Air Navigation, Belgium; Air Traffic Management: Support for Decision Making Optimization - Automation; Dec. 1997; 2p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A01, Hardcopy; A03, Microfiche

In a recent presentation, Dominique Colin de Verdiere considered which areas of air traffic handling need to be optimized. The question is not only pertinent, but must be answered if we are to meet with the intention of turning our attention to the same areas. Several optimization and automation aspects will be discussed in the course of this workshop. In this general introduction, the intention is simply to outline some essential and basic problems concerning the conduct of air traffic.
Derived from text
Dynamic Control; Automatic Flight Control; Automatic Landing Control; Air Traffic Control

19980201659 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. of Flight Guidance, Brunswick, Germany
Dynamic Control of Ground Movements: State-of -the-Art Review and Perspectives
Voelckers, U., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Boehme, D., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Dec. 1997; 12p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Air Traffic Management is a very complex and challenging domain. to cope with future traffic demand, while still maintaining or even increasing safety and efficiency of air traffic operations, intelligent machine functions have to be developed to assist the human operators in their mental control tasks. The specific requirements of the ATM domain necessitate sophisticated and well-designed assistance tools. Their most significant characteristics, design principles and structures are discussed and exemplified in a real-world application.
Author
Air Traffic Control; Dynamic Control; Flight Plans; Man Machine Systems; Flight Optimization

19980201660 Warwick Univ., Operational Research and Systems Group, Coventry, UK
ATFM: Optimisation Approaches
Matos, Paula, Warwick Univ., UK; Dec. 1997; 20p; In English; Also announced as 19980201657; Sponsored in part by Ciencia e Tecnologia.; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

European centralized air traffic flow management (ATFM) is still in its early stages of development and has urgent and extensive needs in terms of decision support tools. This paper provides a brief overview of research in ATFM and discusses the feasibility of optimization approaches to European ATFM. Three optimization models for re-routing air traffic flows and their test results are presented and analyzed.
Author
Air Traffic Control; Flight Paths; Air Traffic; Routes

19980201662 Smiths Industries Aerospace and Defence Systems Ltd., Cheltenham, UK
Flight Management Systems in the New Air Traffic Management (ATM) Environment
Meredith, J. F., Smiths Industries Aerospace and Defence Systems Ltd., UK; Air Traffic Management: Support for Decision Making Optimisation - Automation; Dec. 1997; 10p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The new ATM environment will place additional requirements on Flight Management Systems. It will be necessary to provide data on position and aircraft trajectory to be used by other aircraft and by ground based air traffic managers, at a level of availability and integrity which is consistent with the safety of the air traffic system. Corresponding data from the other aircraft in the airspace must be analyzed in order to identify potential conflicts. The algorithms for the resolution of potential conflict with other aircraft must be based on a common strategy which applies throughout all aircraft. The way in which such conflict resolution could interface with the FMS flight plan and with optimization are discussed.
Author
Flight Management Systems; Air Traffic Control; Flight Optimization; Flight Plans

19980201663 Academie Nationale de l'Air et de l'Espace, Toulouse, France

Impact of Automation on the Optimisation of the Flight

Pelegrin, Marc, Academie Nationale de l'Air et de l'Espace, France; Air Traffic Management: Support for Decision Making Optimization - Automation; Dec. 1997; 12p; In English; Also announced as 19980201657; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The presentation encompasses the following topics regarding flight automation: (1) traffic growth; (2) major technical events in the near future; (3) keywords (terminology); (4) direct impact of automation on safety of the flight; (5) efficiency; (6) pollution control; and finally (7) report synthesis and conclusions.

CASI

Flight Optimization; Automatic Flight Control; Air Traffic; Flight Safety

19980201665 Massachusetts Inst. of Tech., Dept. of Aeronautics and Astronautics, Cambridge, MA USA

ATM as Part of the Aerospace Engineering Curriculum

Simpson, Robert W., Massachusetts Inst. of Tech., USA; Dec. 1997; 4p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A01, Hardcopy; A03, Microfiche

The problems of changing the traditional aerospace engineering curriculum to provide an education for young engineers interested in developing the new forms of ATM (air traffic management) systems is discussed. The new ATM systems will introduce quite different concepts for operational procedures and a much higher level of traffic handling performance using new technologies for communications, navigation, and surveillance identified by the FANS Committee of ICAO, and will introduce digital datalink and automated decision support processes in the cockpit and at the AT controller's console. It is concluded that subjects in human factors and operations research pertinent to ATM operations are badly needed, and that there is not enough time in the normal curriculum to teach all necessary subjects for a completely qualified ATM project engineer so that short courses are needed for engineers from industry to prepare them for this responsibility.

Author

Education; Aerospace Engineering; Flight Management Systems; Air Traffic Control; Human Factors Engineering

19980201666 Air Traffic and Airport Administration, Area Control Centre, Budapest, Hungary

Airspace Organisation and Optimisation

Mavrak, Gabor, Air Traffic and Airport Administration, Hungary; Air Traffic Management: Support for Decision Making Optimization - Automation; Dec. 1997; 18p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The evolution of airspace organization and optimization from the early 1970's to the early 1990's is presented. Special emphasis is given to Hungarian involvement and its peculiarities. Airspace classification, the ATS delegations, dynamic management (strategic planning, pre-tactical planning and the tactical phase), and ongoing projects are considered.

CASI

Management Planning; Airspace; Classifications; Air Traffic

19980201667 European Organization for the Safety of Air Navigation, Brussels, Belgium

Human Role in ATM: Support for Decision Making

Garcia-Avello, Carlos, European Organization for the Safety of Air Navigation, Belgium; Swierstra, Sip, European Organization for the Safety of Air Navigation, Belgium; Dec. 1997; 12p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The ever increasing demand for air traffic is silting up the Air Traffic control system. As a response, the high level management moves towards a business approach: increase system capacity to meet the demand, monitor the quality of the product, in particular safety, and reduce the cost. Air Traffic Control is a complex task that involves human controllers and machines. Today, there is a consensus such that, at least in the enroute environment, the human controller is a major bottle-neck. Accordingly, the introduction of a higher level of automation is considered to be the way forward. The EATCHIP program of Eurocontrol, in close cooperation with its member states is defining the EATCHIP Phase III ATC system generation that aims to improve ATC capacity and flight economy whilst at least maintaining the present safety level. It intends to achieve this by introducing automation in a human-centered approach. The paper describes some human characteristics related to the introduction of automation in general,

current trends in future system automation and associated safety risks. The paper concludes with a proposal for a pragmatic way ahead including how to gain controller acceptance.
Author
Air Traffic Control; Human Performance; Human Factors Engineering; Decision Making; Management Systems; Air Traffic Controllers (Personnel)

19980201668 Centre d'Etudes et de Recherches, Toulouse, France
Optimization Techniques as Available for On-Line Operations
Imbert, Nicole, Centre d'Etudes et de Recherches, France; Farges, Jean Loup, Centre d'Etudes et de Recherches, France; Dec. 1997; 18p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

In the frame of this workshop dedicated to support for decision making optimization and automation, it appeared useful to the organizing team to include a general presentation of what optimization means and of the various existing methods to solve optimization problems. In this paper we will try to classify the optimization techniques according to the type of problems they are intended to solve and to the type of solutions that may be expected for each of them. We do not try to solve exhaustively as we are more concerned with the general methodologies. In fact many methods exist. For all types of methods, adaptations and improvements have been developed in order to increase their efficiency, their rate of convergence or decrease computing time. For specific applications, the best results are often obtained from the combination of several algorithms. In taking advantage of the specificity of each, efficient methods are then obtained.
Author
On-Line Systems; Decision Making; Mathematical Programming; Mathematical Models

19980201669 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. fuer Flugfuehrung, Brunswick, Germany
PHARE Demonstration: Arrivals Management
Reichmuth, Johannes, Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Dec. 1997; 12p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper reports first results obtained from the real-time simulations in the frame of the second PHARE Demonstration (PD/2) performed during December 1996 to February 1997 at DLR in Brunswick. The experimental set-up of three different configurations for the management of arrivals in an extended TMA airspace using the Tools developed within the PHARE program in connection with DLRs Air Traffic Management and Operations Simulator (ATMOS) is described. A conventional arrival management system is compared with advanced arrival management based on time accurate trajectory predictions provided from ground as well as from the air. An overview on the advanced Ground Human Machine Interface developed for these experiments is given. Eight controller teams from seven European countries take part on the experiment. The first analysis of the collected data in terms of performance, workload and acceptance supports the ideas of the presented operational concepts for the Approach problem further to be included within future Air Traffic Management Systems.
Author
Flight Management Systems; Air Traffic Control; Arrivals; Air Traffic; Flight Paths; Trajectory Planning; Approach Control

19980201670 Centre d'Etudes de la Navigation Aerienne, Lab. d'Optimisation Globale, Toulouse, France
Optimal Resolution of En Route Conflicts
Durand, Nicolas, Centre d'Etudes de la Navigation Aerienne, France; Alliot, Jean-Marc, Centre d'Etudes de la Navigation Aerienne, France; Dec. 1997; 12p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Automatic control has been a subject of studies for the last twenty years. It involves many difficult problems that have to be solved: conflict detection, modelling of uncertainties on trajectories, clustering of 1-to-1 conflict to find unconnected n-aircraft problems, etc... Moreover, the n-aircraft conflict resolution problem is highly combinatorial and cannot be optimally solved using classical mathematical optimization techniques. The set of admissible solutions is made of many unconnected subsets enclosing different local optima, but the subset enclosing the optimum cannot be found a priori. In this paper, we present an automatic conflict solver and its implementation in an air traffic simulator, with statistical results on real traffic over France. This solver, which takes into account speed uncertainties and allows aircraft to fly on direct routes, solves every conflict on a loaded day, and gives each aircraft its requested flight level and departure time.
Author
Automatic Flight Control; Simulators; Routes; Air Traffic; Flight Management Systems; Optimization; Real Time Operation; Mathematical Models; Control Simulation

19980201671 Global Air Traffic Management, Athens, Greece

Global Air Traffic Management (GATM)

Trivizas, Dionyssios A., Global Air Traffic Management, Greece; Dec. 1997; 12p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The paper describes concepts that relate to Global Air Traffic Management(GATM) emphasizing the potential of mathematical modeling and behavioral simulation in creating a flexible and efficient traffic management system. These concepts include design methodology, flow management, airspace structure and optimal runway scheduling. They reflect the author's theoretical study and experience on the subject of Air Traffic Control, combining knowledge and ideas from related large scale optimal dynamic resource allocation problems encountered in military logistics, transportation and economics. The resource in question is the airspace-time and the paper discusses alternative ways, such as the space-time market, for sharing it in a safe, expedient and cost effective way. The paper concludes with optimal runway capacity results for the two major airports of Frankfurt and Chicago O'Hare.

Author

Air Traffic Control; Management Systems; Mathematical Models; Resource Allocation; Space-Time Functions; Scheduling; Operations Research; Dynamic Programming; Stochastic Processes

19980201672 Global Air Traffic Management, Athens, Greece

Optimal Scheduling With Maximum Position Shift (MPS) Constraints: A Runway Scheduling Application

Trivizas, Dionyssios A., Global Air Traffic Management, Greece; Dec. 1997; 10p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The airport's runway system may be viewed as a queueing system where a stream of flights is waiting to receive take-off or landing "service". It has been observed that changing the order of runway operations results in a different runway throughput or "capacity". This is due to wake vortex considerations, whereby the minimum horizontal separations between successive landing aircraft depends on their weight and final approach speed. This observation gave rise to the Optimal Runway Scheduling Problem (RSP) that seeks to find the optimal rearrangement of flights that would maximize runway throughput. RSP is complicated by the fact that in a real time system, where flights appear randomly over time, there is always a possibility of some flight being indefinitely displaced backwards in the queue. This calls for the Maximum Position Shift (MPS) constraints which assure that no flight will be displaced in the queue by more than a pre-specified number k of positions. The term queue refers to the ordering of flights according to the First Come First Served (FCFS) discipline. The RSP is typical of queueing systems when service rate depends on customer ordering. It is also a variation of the notorious Traveling Salesman Problem (TSP). The paper presents the Parallel Dynamic Programming RSP algorithm, developed in Trivizas' doctoral dissertation. Timely solution is crucial to real time dynamic scheduling, and so the paper concentrates on its computational aspects. It is shown that the MPS constraints reduce the size of the problem's solution space, interpreted as a computational neighborhood around the FCFS sequence of "radius" equal to the MPS value. This neighborhood has the form of a permutation tree (PT). It is shown here that traversing the PT using a Branch and Bound (BB) Depth First Search, a brute force method, may require an amount of time which is exponential in the number n of customers (flights). It is further shown that the search may be organized efficiently using Breadth First Search Dynamic Programming which exploits the de-coupled, stage invariant solution space structure, whose size, 2(exp MPS)x n, is linear in n and exponential only in the bounded value of MPS. Stage invariance and label vector coding of the solution space allow for a generalized cross-section of the solution space; this leads to the concept of a parallel computation engine that sweeps the solution space in time linear in n.

Author

Programming (Scheduling); Dynamic Programming; Runways; Parallel Programming; Nonlinear Programming; Sequencing; Combinatorial Analysis; Air Traffic Control; Flight Management Systems

19980201673 Steria Automatisme et Ingenierie, Air Traffic Management Dept., Paris, France

Airborne Conflict Detection and Resolution Using Coupled Forces Field Technique: Principles and Results

Zeghal, Karim, Steria Automatisme et Ingenierie, France; Dec. 1997; 12p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper presents an airborne conflict detection and resolution logic, based on the coupled forces field technique. This technique defines a general framework for decentralized and reactive coordination for mobile agents. An experiment has been carried out to evaluate this approach. The background, role of controllers and pilots, and what type of principles and the application of the technique to air traffic, as well as the principal results are presented.

Author

Air Traffic; Flight Management Systems; Coordination; Field Theory (Physics); Air Traffic Control

19980201674 Air Traffic and Airport Administration, Air Traffic Control Evaluation Unit, Budapest, Hungary
Human-Machine Interface (HMI) in the Magyar Automated and Integrated Air Traffic Control System (MATIAS)
Galantai, N., Air Traffic and Airport Administration, Hungary; Dec. 1997; 8p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The Hungarian Air Traffic and Airport Administration is to replace the current Budapest Area Control Centre (ACC) with a new, purpose-built building at Ferihegy. The new ACC system is planned to be fully stripless and will include area control, terminal area control, aerodrome control, military control and flight information sectors. Readers involved in air traffic control may find it interesting how the system is planned to fulfill the controllers' requirements. The article contains the description of those functions, which are planned to be used by the operational staff in the OPS Room, so the technical and maintenance windows are omitted. The windows of the radio and telephone systems are also omitted.
Author
Air Traffic Control; Human-Computer Interface; Flight Management Systems; Windows (Computer Programs); Display Devices

19980201675 Federal Aviation Administration, Program Director for Research, Washington, DC USA
Plans and Perspectives for Research and Development in Air Traffic Management
Miller, Clyde A., Federal Aviation Administration, USA; Dec. 1997; 16p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

In 1993, the U.S. Congress passed the Government Performance and Results Act (GPRA). The purpose of the legislation is to improve Federal program effectiveness and public accountability by promoting a focus on results, service quality and customer satisfaction. The GPRA shifts the focus of program accountability from agency internal activities to the products and services planned to be placed in the hands of external customers and the eventual benefits to be achieved as a result. Decisions regarding expenditures of public funds will be justified in terms of these products, services and benefits. This perspective is very useful in planning and prioritizing research and development (R&D) projects in air traffic management (ATM). In particular, it would be useful to establish a comprehensive framework of performance goals to guide R&D investments in ATM. Some progress toward this end has been achieved at the Federal Aviation Administration (FAA).
Author
Air Traffic Control; Flight Management Systems; Research and Development

19980201676 Direction de la Navigation Aerienne, Defense Nuclear Agency, Issy-Ies-Moulineaux, France
CNS/ATM Concept: ICAO Prospective
Dedryvere, A., Direction de la Navigation Aerienne, France; Carel, O., Direction de la Navigation Aerienne, France; Dec. 1997; 16p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

In 1983, ICAO founded the FANS Committee (Future Air Navigation System) to trigger a global reflection on the radioelectric means to be used by Civil Aviation in 2000 and further. In dense areas (like the European core area between London, Paris, Milan, Berlin and Amsterdam) the growth of traffic will no more be manageable by the current control methods, ie. multiplying the number of sectors more and more. En-route and airport delays generate time and financial losses. In oceanic and desertic areas the traffic is low and will remain low for a long time. The lack of communication and navigation means generates large lateral and longitudinal separations which sometimes do not avoid near misses over continental crosspoints. There was a need for more reliable but affordable controller-to-controller and controller-to-pilot links associated with modern and reliable navigation aids. Aviation is generally famous for technical modernity but the International Maritime Organization was the first to implement a satellite communication system designed between 1976 and 1979 and put into operation on 01/02/1982. It was then possible for maritime crew and travelers to phone everywhere in the world, when aircraft pilots were unable to have a comfortable contact with ATC.
Author
Air Traffic Control; Air Navigation; Ground-Air-Ground Communication; Navigation Aids; Flight Management Systems

19980201677 European Organization for the Safety of Air Navigation, Experimental Centre, Bretigny-sur-Orge, France
The Way Forward, a European Perspective
Fron, Xavier, European Organization for the Safety of Air Navigation, France; Dec. 1997; 24p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Some ideas about what may be coming next in European Air Traffic Management (ATM) are presented. More specifically, the following items will be discussed: (1) Why is there a need to act at all; (2) An attempt to explain existing plans in Europe to

address challenges; and (3) to show that we have at least some idea of how to address those challenges, by presenting some results, which will lead us to a possible path forward, and finally to conclusions.
Derived from text
Air Traffic Control; Flight Management Systems; Management Planning; Europe

19980201753 Oklahoma Univ., Civil Aeromedical Inst., Norman, OK USA
The Role of Memory in Air Traffic Control ***Final Report***
Gronlund, Scott D., Oklahoma Univ., USA; Dougherty, Michael R., Oklahoma Univ., USA; Ohrt, Daryl D., Oklahoma Univ., USA; Thomson, Gary L., Oklahoma Univ., USA; Bleckley, M. K., Oklahoma Univ., USA; Nov. 1997; 25p; In English
Contract(s)/Grant(s): DTFA02-93-D-93088
Report No.(s): AD-A340263; DOT/FAA/AM-97/22; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We tested air traffic controllers currently serving as instructors and tried to manipulate their memory for various aircraft flight data. In Experiment 1, the amount of control exercised (the number of control actions or communications) had little effect on memory for flight data, although we did find excellent memory for the position of aircraft on the radar display. We argued that this was the basis for the mental representation of the aircraft in the sector and may serve as the foundation for situation awareness. In Experiment 2, neither the type of control exercised nor the importance of the aircraft in the scenario consistently affected memory. We considered several reasons why we were unable to manipulate memory for flight data, including how important memory is to successful task performance and whether we tapped the relevant characteristics of the situation. Resolution of these issues will contribute to improved techniques that assess situation awareness from memory performance.
DTIC
Air Traffic Control; Radarscopes

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19980197301 NASA Langley Research Center, Hampton, VA USA
Experimental and Theoretical Study of Flow Fields Around Ducted-Nacelle Models
Mack, Robert J., NASA Langley Research Center, USA; May 1998; 24p; In English
Contract(s)/Grant(s): RTOP 537-07-21-21
Report No.(s): NASA/TM-1998-207683; L-17741; NAS 1.15:207683; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The flow field near four small-scale ducted-nacelle bodies of revolution has been analytically and experimentally studied to determine exterior and interior mass-flow characteristics, and to measure flow-field overpressures generated by the nacelle's forebody shape. Four nacelle models with the same profile, but of different sizes, were used in the study. Shadowgraph pictures showed inlet shocks attached to the cowl lip (indicating unchoked flow) on all four models, at all the test Mach numbers, through an angle of attack range of 0.0 to 6.0 degrees. Pressure signatures measured in the flow field of the largest of the four nacelle models were compared with those predicted by corrected and uncorrected Whitham theory. At separation distances greater than 3.0 to 4.0 inlet diameters, good agreement was found. Poorer agreement was found at extreme near-field separation distances, but this was attributed to pressure-gage limitations and probe-flow field interactions. The overall favorable results supported a conclusion that corrected Whitham theory was sufficiently accurate to make the nacelle-wing interference-lift code useful for sonic-boom analysis and the preliminary design of supersonic-cruise conceptual aircraft.
Author
Nacelles; Ducted Flow; Mach Number; Ducted Bodies; Flow Characteristics; Fluid Flow; Angle of Attack; Aircraft Design

19980200821 Northrop Grumman Corp., Military Aircraft Systems Div., El Segundo, CA USA
Corrosion and Fatigue Study of JSTARS Aircraft, Volume 1 ***Final Report, 3 Jul. 1996 - 3 Apr. 1997***
Pun, A. K., Northrop Grumman Corp., USA; Sheppard, W. R., Northrop Grumman Corp., USA; Purohit, S. K., Northrop Grumman Corp., USA; Apr. 1997; 158p; In English
Contract(s)/Grant(s): F33615-95-D-3215; AF Proj. 2401
Report No.(s): AD-A286965; NOR-97-809-VOL-1; WL-TR-97-3093-Vol-1; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Findings and supporting information from a survey performed in two E8-C Joint STARS aircraft are presented. An access database was formed recording corrosion and fatigue damage from a survey of the teardown documentation of the third and fourth production Joint STARS aircraft. Analysis and commentary on the database are presented. Emphasis was placed on corrosion and fatigue damage of primary structural elements.
DTIC
Corrosion; Fatigue (Materials); Electronic Aircraft; Damage Assessment; Fatigue Tests; Aircraft Structures; Inspection

19980200827 Air Force Flight Test Center, Edwards AFB, CA USA
A Limited Flight Test Investigation of Pilot-Induced Oscillation Due to Elevator Rate Limiting (HAVE LIMITS) ***Final Report, 1 Mar. - 25 Apr. 1997***
Kish, Brian A., Air Force Flight Test Center, USA; Mosle, William B., III, Air Force Flight Test Center, USA; Remaly, Adam, Air Force Flight Test Center, USA; Seo, John, Air Force Flight Test Center, USA; Cabiati, Roberto, Air Force Flight Test Center, USA; Jun. 1997; 140p; In English
Report No.(s): AD-A286959; AFFTC-TR-97-12; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
The report presents the results of a limited flight test investigation of pilot-induced oscillation (PIO) due to elevator rate limiting. The objective of this effort was to gather in-flight and ground-based simulation data on longitudinal PIO tendencies due to elevator rate limiting. Preliminary, ground-based simulation was conducted at the USAF Test Pilot School (TPS) from 1 March to 9 April 1997. Nine sorties, totaling 12.8 flight hours, were flown in the NT-33A aircraft. Additional ground-based simulation was conducted at the Flight Dynamics Directorate, Wright-Patterson AFB, Ohio, on 25 April 1997. The USAF TPS was the responsible test organization.
DTIC
Pilot Induced Oscillation; Flight Tests; Research Aircraft; Elevators (Control Surfaces); Man Machine Systems

19980200836 Rohr Corp., Chula Vista, CA USA
Thermal Management Design for the X-33 Lifting Body
Bouslog, S., Rohr Corp., USA; Mammano, J., Rohr Corp., USA; Strauss, B., Rohr Corp., USA; 1998; 18p; In English; 3rd; European Workshop on Thermal Protection Systems, 25-27 Mar. 1998, Netherlands
Contract(s)/Grant(s): NCC8-115
Report No.(s): NASA/CR-1998-208247; NAS 1.26:208247; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The X-33 Advantage Technology Demonstrator offers a rare and exciting opportunity in Thermal Protection System development. The experimental program incorporates the latest design innovation in re-useable, low life cycle cost, and highly dependable Thermal Protection materials and constructions into both ground based and flight test vehicle validations. The unique attributes of the X-33 demonstrator for design application validation for the full scale Reusable Launch Vehicle, (RLV), are represented by both the configuration of the stand-off aeroshell, and the extreme exposures of sub-orbital hypersonic re-entry simulation. There are several challenges of producing a sub-orbital prototype demonstrator of Single Stage to Orbit/Reusable Launch Vehicle (SSTO/RLV) operations. An aggressive schedule with budgetary constraints precludes the opportunity for an extensive verification and qualification program of vehicle flight hardware. However, taking advantage of off the shelf components with proven technologies reduces some of the requirements for additional testing. The effects of scale on thermal heating rates must also be taken into account during trajectory design and analysis. Described in this document are the unique Thermal Protection System (TPS) design opportunities that are available with the lifting body configuration of the X-33. The two principal objectives for the TPS are to shield the primary airframe structure from excessive thermal loads and to provide an aerodynamic mold line surface. With the relatively benign aeroheating capability of the lifting body, an integrated stand-off aeroshell design with minimal weight and reduced procurement and operational costs is allowed. This paper summarizes the design objectives of the X-33 TPS, the flight test requirements driven configuration, and design benefits. Comparisons are made of the X-33 flight profiles and Space Shuttle Orbiter, and lifting body Reusable Launch Vehicle aerothermal environments. The X-33 TPS is based on a design to cost configuration concept. Only RLV critical technologies are verified to conform to cost and schedule restrictions. The one-off prototype vehicle configuration has evolved to minimize the tooling costs by reducing the number of unique components. Low cost approaches such as a composite/blanket leeward aeroshell and the use of Shuttle technology are implemented where applicable. The success of the X-33 will overcome the ballistic re-entry TPS mindset. The X-33 TPS is tailored to an aircraft type mission while maintaining sufficient operational margins. The flight test program for the X-33 will demonstrate that TPS for the RLV is not simply a surface insulation but rather an integrated aeroshell system.
Author
Thermal Protection; Temperature Control; X-33 Reusable Launch Vehicle; Design to Cost; Lifting Reentry Vehicles; Structural Design; Structural Design Criteria; Airframes; Aircraft Construction Materials

19980200860 Institute for Human Factors TNO, Soesterberg, Netherlands

Remotely Controlled Flying Aided by a Head-Slaved Camera and HMD ***Final Report Afstand bestuurd vliegen ondesteund door een hoofd-gekoppelde camera en HMD***

deVries, S. C., Institute for Human Factors TNO, Netherlands; Padmos, P., Institute for Human Factors TNO, Netherlands; Dec. 08, 1997; 22p; In English

Contract(s)/Grant(s): B96-032

Report No.(s): TNO-TM-97-B024; TD97-0261; Copyright; Avail: Issuing Activity (TNO Human Factors Research Inst., Kampweg 5, 3769 DE Soesterberg, The Netherlands); US Sales Only, Hardcopy, Microfiche

Military use of Unmanned Aerial Vehicles (UAVs) is gaining importance. Video cameras in these devices are often operated with joysticks and their image is displayed an a CRT. In this experiment, the simulated camera of a simulated UAV was slaved to the operator's head movements and displayed using a Helmet Mounted Display (HMD). The task involved maneuvering a UAV along a winding course marked by trees. The influence of several parameters of the set-up (HMD optics, Field of View (FOV), image tag, monocular vs. stereoscopic presentation) on a set of flight handling characteristics was assessed. to enable variation of FOV and to study the effect of the HMD optics, a simulated HMD image consisting of a head slaved window (with variable FOV), was projected on a screen. One of the FOVs, generated in this way, corresponded with the FOV of the real HMD, enabling a comparison. The results show that the simulated HMD yields a significantly better performance than the real HMD. Performance with a FOV of 17 deg is significantly lower than with 34 or 57 deg. An image lag of 50 ms, typical of pan-and-tilt servo motor systems, has a small but significant influence on steering accuracy. Monocular and stereoscopic presentation did not result in significant performance differences.

Author

Field of View; Helmet Mounted Displays; Remote Control; Flight Characteristics; Cathode Ray Tubes; Pilotless Aircraft; Cameras

19980200870 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA

Embedding a Reactive Tabu Search Heuristic in Unmanned Aerial Vehicle Simulations

Ryan, Joel L., Air Force Inst. of Tech., USA; Mar. 1998; 260p; In English

Report No.(s): AD-A342293; AFIT/GOR/ENS/98M-20; AFIT/GOR/ENS/98M-21; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

We apply a Reactive Tabu Search (RTS) heuristic within a discrete event simulation to solve routing problems for Unmanned Aerial Vehicles (UAVs). Our formulation represents this problem as a multiple Traveling Salesman Problem with time windows (mTSPTW), with the objective of attaining a specified level of target coverage using a minimum number of vehicles. Incorporating weather and probability of UAV survival at each target as random inputs, the RTS heuristic in the simulation searches for the best solution in each realization of the problem scenario in order to identify those routes that are robust to variations in weather, threat, or target service times. Generalizing this approach as Embedded Optimization (EO), we define EO as a characteristic of a discrete event simulation model that contains optimization or heuristic procedures that can affect the state of the system. The RTS algorithm in the UAV simulation demonstrates the utility of EO by determining the necessary fleet size for an operationally representative scenario. From our observation of robust routes, we suggest a methodology for using robust tours as initial solutions in subsequent replications. We present an object oriented implementation of this approach using MODSIM III, and show how mapping object inheritance to the GVRP hierarchy allows for minimal adjustments from previously written objects when creating new types. Finally, we use EO to conduct an analysis of fleet size requirements within an operationally representative scenario. DTIC

Computerized Simulation; Target Acquisition; Remotely Piloted Vehicles; Simulation; Pilotless Aircraft

19980200871 Naval Postgraduate School, Monterey, CA USA

A Reliability Centered Maintenance Analysis of Aircraft Control Bearings Used in the Navy's S-3 Aircraft

King, Merrill F., Jr, Naval Postgraduate School, USA; Dec. 1997; 85p; In English

Report No.(s): AD-A342292; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This thesis uses the Naval Air Systems Command Integrated Reliability Centered Maintenance Program software (IRCMS) to analyze the performance of aircraft control bearings used in the flight control system of the Navy's S-3 aircraft. The IRCMS is used to determine whether changes can be made in preventative maintenance procedures, or if redesign of the system is warranted. We show in our analysis that each bearing should be redesigned. In our research, we analyzed and established a historical bearing failure data baseline of current reliability and maintenance costs. We developed a mathematical model to determine the effects of using improved bearings, currently available from commercial manufacturers, on bearing reliability and life cycle costs. We show that failure rates can be reduced by 50 percent, and maintenance costs can be reduced by 48 percent, which represents

$16,000 in annual savings over the remaining life of the aircraft. We show that an increase in bearing and flight control system reliability is important from the aspect of aircrew safety, and reduces the exposure of aircrews to the potential of in-flight failures. DTIC

Reliability Analysis; S-3 Aircraft; Military Technology; Aircraft Maintenance

19980200994 NASA Langley Research Center, Hampton, VA USA

Closed-Loop System Identification Experience for Flight Control Law and Flying Qualities Evaluation of a High Performance Fighter Aircraft

Murphy, Patrick C., NASA Langley Research Center, USA; [1996]; 14p; In English

Report No.(s): NASA/TM-1998-207995; NAS 1.15:207995; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper highlights some of the results and issues associated with estimating models to evaluate control law design methods and design criteria for advanced high performance aircraft. Experimental fighter aircraft such as the NASA-High Alpha Research Vehicle (HARV) have the capability to maneuver at very high angles of attack where nonlinear aerodynamics often predominate. HARV is an experimental F/A-18, configured with thrust vectoring and conformal actuated nose strakes. Identifying closed-loop models for this type of aircraft can be made difficult by nonlinearities and high order characteristics of the system. In this paper, only lateral-directional axes are considered since the lateral-directional control law was specifically designed to produce classical airplane responses normally expected with low-order, rigid-body systems. Evaluation of the control design methodology was made using low-order equivalent systems determined from flight and simulation. This allowed comparison of the closed-loop rigid-body dynamics achieved in flight with that designed in simulation. In flight, the On Board Excitation System was used to apply optimal inputs to lateral stick and pedals at five angles at attack : 5, 20, 30, 45, and 60 degrees. Data analysis and closed-loop model identification were done using frequency domain maximum likelihood. The structure of identified models was a linear state-space model reflecting classical 4th-order airplane dynamics. Input time delays associated with the high-order controller and aircraft system were accounted for in data preprocessing. A comparison of flight estimated models with small perturbation linear design models highlighted nonlinearities in the system and indicated that the closed-loop rigid-body dynamics were sensitive to input amplitudes at 20 and 30 degrees angle of attack.

Author

Flight Control; Fighter Aircraft; Rigid Structures; Control Simulation; Control Systems Design; Control Theory; Flight Simulation; Research Aircraft; Feedback Control

19980201050 Army Aviation and Missile Command, Aeroflightdynamics Directorate, Hampton, VA USA

A Comparison of Interactional Aerodynamics Methods for a Helicopter in Low Speed Flight

Berry, John D., Army Aviation and Missile Command, USA; Letnikov, Victor, Mil Moscow Helicopter Plant, Russia; Bavykina, Irena, Mil Moscow Helicopter Plant, Russia; Chaffin, Mark S., Lockheed Martin Engineering and Sciences Co., USA; Jun. 1998; 16p; In English

Contract(s)/Grant(s): RTOP 581-10-11-01

Report No.(s): NASA/TM-1998-208420; L-17732; NAS 1.15:208420; AFDD/TR-98-A-003; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Recent advances in computing subsonic flow have been applied to helicopter configurations with various degrees of success. This paper is a comparison of two specific methods applied to a particularly challenging regime of helicopter flight, very low speeds, where the interaction of the rotor wake and the fuselage are most significant. Comparisons are made between different methods of predicting the interactional aerodynamics associated with a simple generic helicopter configuration. These comparisons are made using fuselage pressure data from a Mach-scaled powered model helicopter with a rotor diameter of approximately 3 meters. The data shown are for an advance ratio of 0.05 with a thrust coefficient of 0.0066. The results of this comparison show that in this type of complex flow both analytical techniques have regions where they are more accurate in matching the experimental data.

Author

Helicopters; Subsonic Flow; Interactional Aerodynamics; Computational Fluid Dynamics; Aircraft Configurations; Aerodynamic Configurations

19980201081 Nanjing Univ. of Aeronautics and Astronautics, Nanjing, Jiangsu, China

Journal of Nanjing University of Aeronautics and Astronautics: Special Issue on Helicopter Technology

Dec. 1997; Volume 29, No. 6; 152p; In Chinese; Portions of this document are not fully legible

Report No.(s): PB98-141658; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Contents; (Summarization): Helicopter Development Facing 21 Century; New Developments of Helicopter Technology; Smart Rotor--A New Approach with Remarkable Potential for Helicopter Vibration Reduction; and Active Control Technology of Helicopter Aeromechanics Stability.
NTIS
Helicopters; Research and Development; Rotary Wings; Stability; Aeronautical Engineering; Vibration

19980201124 NASA Langley Research Center, Hampton, VA USA
Advances in Experiment Design for High Performance Aircraft
Morelli, Engene A., NASA Langley Research Center, USA; 1998; 20p; In English; System Identification for Integrated Aircraft Development and Flight Testing, 5-7 May 1998, Madrid, Spain; Sponsored by North Atlantic Treaty Organization, Belgium
Report No.(s): NASA/TM-1998-207994; NAS 1.15:207994; Paper-8; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A general overview and summary of recent advances in experiment design for high performance aircraft is presented, along with results from flight tests. General theoretical background is included, with some discussion of various approaches to maneuver design. Flight test examples from the F-18 High Alpha Research Vehicle (HARV) are used to illustrate applications of the theory. Input forms are compared using Cramer-Rao bounds for the standard errors of estimated model parameters. Directions for future research in experiment design for high performance aircraft are identified.
Author
Supersonic Aircraft; Research Vehicles; Cramer-Rao Bounds; F-18 Aircraft

19980201195 Naval Air Warfare Center, Structures Div., Patuxent River, MD USA
Highly Damped Structure, Part 2*, Oct. 1994 - Oct 1997*
Barrett, David John, Naval Air Warfare Center, USA; Ray, Hemen, Naval Air Warfare Center, USA; Arocho, Annette, Naval Air Warfare Center, USA; Werczynski, Glenn, Naval Air Warfare Center, USA; Dec. 04, 1997; 50p; In English
Report No.(s): AD-A342058; NAWCADPAX--97-249-TR-PT-2; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes a research and development program whose goal was the development of vibration and fatigue resistant structure. The approach was based on the application of passive damping technology to the redesign of structural components. The specific components addressed included the skins of the beavertail section of the F-14D and the spars of a half-scale test bed of the F/A-18 vertical tails. Integrally damped structure was achieved through the cocuring of damping materials with advanced composites. The results show that benefits can be obtained by including damping as a parameter in the design of parts that experience dynamic loads.
DTIC
Aircraft Design; F-14 Aircraft; Aircraft Structures; Structural Design; Tail Assemblies; Composite Structures; Composite Materials; Vibration Damping

19980201290 Naval Research Lab., Off-Board Countermeasures Branch, Washington, DC USA
An Investigation of the Aerodynamic Performance of the Spin-Wing Concept *Interim Report*
Tayman, Steven K., Naval Research Lab., USA; Walden, Andrea B., Naval Research Lab., USA; Feb. 27, 1998; 17p; In English
Report No.(s): AD-A339474; NRL/MR/5710-98-8147; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Unmanned air vehicles (UAV's) capable of vertical takeoff and landing (VTOL) are always of interest to the Navy. This paper examines the aerodynamic performance of a unique multi-mode aircraft concept called the spin-wing/stop rotor. The spin wing uses its wing and tail as a counter-rotating rotor system for hovering flight. For forward flight, the wing and tail are stopped.
DTIC
Aerodynamic Characteristics; Vertical Takeoff Aircraft; Vertical Takeoff; Aircraft Design

19980201329 Rome Univ., Rome, Italy
CEAS International Forum on Aeroelasticity and Structural Dynamics. Informal Conference Proceedings
Jan. 1997; 10p; In English, 1997; Sponsored by National Oceanic and Atmospheric Administration, USA
Report No.(s): AD-A338265; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The main trust of the Forum was: Aeroelasticity and Structural Dynamics. In particular, the Forum included the following topics: (1) unsteady aerodynamics and aeroelastic characteristics of aerospace structures, (2) structural modeling and optimization, (3) active control and smart structures, (4) certification and qualification, and (5) testing for validation.
DTIC
Conferences; Aircraft Design; Aeroelasticity; Dynamic Structural Analysis

19980201417 General Accounting Office, Washington, DC USA

F-22 Aircraft: Progress in Achieving Engineering and Manufacturing Development Goals

Mar. 1998; 33p; In English

Report No.(s): AD-A338913; GAO/NSIAD-98-67; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The F-22 is an air superiority aircraft with the capability to deliver air to ground weapons. The most significant advanced technology features include supercruise, the ability to fly efficiently at supersonic speeds without using fuel consuming afterburners; low observability to adversary systems; and integrated avionics to significantly improve the pilot's situational awareness. The objectives of the F-22 EMD program, begun in 1991, are to (1) design, fabricate, test, and deliver 9 F-22 flight test vehicles, 2 ground test articles, %nd 26 flight qualified engines; (2) design, fabricate, integrate, and test the avionics suite; and (3) design, develop, and test th e F-22 system support and training systems.

DTIC

F-22 Aircraft; Product Development; Manufacturing; Fabrication; Flight Test Vehicles; Ground Tests

19980201517 Analytical Services and Materials, Inc., Hampton, VA USA

Development of Structural Integrity Analysis Technologies for Aging Aircraft Structures: Bonded Composite Patch Repair and Weight Function Methods ***Final Report, Nov. 1995 - Jul. 1996***

Boyd, K. L., Analytical Services and Materials, Inc., USA; Krishnan, S., Analytical Services and Materials, Inc., USA; Litvinov, A., Analytical Services and Materials, Inc., USA; Elsner, J. H., Analytical Services and Materials, Inc., USA; Ratwani, M. M., Analytical Services and Materials, Inc., USA; Jul. 1997; 142p; In English

Contract(s)/Grant(s): F33615-94-D-3212; AF Proj. 2401

Report No.(s): AD-A338907; WL-TR-97-3105; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

The purpose of this research was to develop advanced structural integrity analysis methods for aging aircraft structures. The primary focus of this study was to develop a method for performing fatigue crack growth analyses under a composite (repair patch) on a metallic structure. Also, it was envisioned that these methods would be incorporated into the fatigue crack growth software, AFGROW, so that this promising technology can be transitioned to U.S. Air Force Logistic Centers, U.S. Air Force contractors and other government agencies as quickly as possible. Fatigue cracks growing from fastener holes, or multiple fastener holes, also are common problems found in aging aircraft. to address these problems, analytical methods (weight functions) were developed to assist engineers in the analysis of fatigue cracks growing in arbitrary stress fields, commonly found around cold-worked fastener holes and stop-drilled cracks. Furthermore, an approach to evaluate multiple cracking, or multiple-site damage (MSD), was developed as a future enhancement to the AFGROW program.

DTIC

Aircraft Structures; Aircraft Maintenance; Fatigue (Materials); Crack Propagation; Structural Analysis; Stress Analysis

19980201521 Texas Univ., Fast Center for Structural Integrity of Aerospace Systems, El Paso, TX USA

(HBCU/MI) Workshop on Intelligent NDE Sciences for Aging and Futuristic Aircrafts ***Final Report, 15 Jul. - 14 Dec. 1997***

Osegueda, Roberto A., Texas Univ., USA; Ferregut, Carlos, Texas Univ., USA; Nazarian, Soheil, Texas Univ., USA; Arrowood, Roy, Texas Univ., USA; Mar. 1998; 306p; In English

Contract(s)/Grant(s): F49620-97-1-0470; AF Proj. 4276

Report No.(s): AD-A340484; AFRL-SR-BL-TR-98-0253; No Copyright; Avail: CASI; A14, Hardcopy; A03, Microfiche

This volume contains the papers of the workshop on Intelligent NDE Sciences for Aging and Futuristic Aircraft held at the University of Texas at El Paso on September 30 - October 2, 1997. The workshop was organized to assess the state-of-the-art in the emerging field and to provide a forum to discuss and identify key basic and applied research issues that are critical to the development of intelligent NDE systems for aircraft.

DTIC

Decision Making; Artificial Intelligence; Nondestructive Tests

19980201549 Army Command and General Staff Coll., School of Advanced Military Studies, Fort Leavenworth, KS USA

The Future of Fixed-Wing Close Air Support: Does the Army Need it to Fight?

Weber, Edward V., Army Command and General Staff Coll., USA; Dec. 18, 1997; 66p; In English

Report No.(s): AD-A340180; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The issue of close air support is one of the most emotional issues between the Army and the Air Force. Both services interpret close air support in terms of the lives of their personnel. The fundamental question previous studies have not addressed is why the Army wants or needs fixed wing close air support? If it is 'the decisive force,' why does it need help from another service?

A combat effective combined arms forces should not need fixed wing close air support or needs it only when its organic fire support is unavailable. Army and Air Force doctrine is compared to determine how the services think about war in general, and close air support specifically. Current Army and Joint doctrine admit that rotary wing as well as fixed wing aircraft can perform the mission. However, some Army officers see the helicopter as a maneuver element and therefore not. The study examines World War II and the Gulf War to demonstrate the major thesis. During World War II, specifically the Battle for France in 1944-45, the U.S. Army was not as 'combat effective' as the German Army opposing it and often required fixed wing aircraft and artillery to make-up the difference. The Gulf War demonstrates that the Army can dominate th e close fight, because its combat effectiveness and better weapons surpassed the Iraqis. The principal operational requirement for close support is to destroy armored weapons systems; tank, artillery, infantry fighting vehicles. The Army's attack helicopter and artillery systems provide the means to meet this requirement. Because they are organic they are more responsive and can be integrated more readily into the ground commander's scheme of maneuver than Air Force aircraft. Improvements to artillery systems will increase close support capabilities as well. The conclusion is the Army can perform all the close support tasks it requires.
DTIC
Support Systems; Helicopters; Emotional Factors; Armed Forces (USA); Tactics

19980201572 Veda, Inc., Dayton, OH USA
Piloted Simulation of an F-16 Flight Control System Designed Using Quantitative Feedback Theory ***Final Report, Feb. 1996 - Sep. 1997***
Sheldon, Stuart N., Veda, Inc., USA; Sep. 1997; 99p; In English
Contract(s)/Grant(s): F33615-92-D-3602; AF Proj. 2403
Report No.(s): AD-A339188; WL-TR-97-3091; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

The purpose of this report is to determine the applicability of the Quantitative Feedback Theory (QFT) approach to designing the control laws for a modern military flight control system. This report documents a portion of the QFT research program, specifically, the implementation of a QFT design on a manned simulation of the NF-16D Variable Stability Inflight Simulator Test Aircraft (VISTA F-16). The control law design addresses the subsonic flight envelope of the VISTA F-16 including changes in aircraft configuration. The design was accomplished as a SISO longitudinal loop and a MIMO lateral loop, and incorporates pilot handling qualities within the specifications. Imbedding handling qualities in the system through prudent choice of control variable ensured that the performance specifications were met. Flexibility in the prefilter design allowed the closed loop response to be shaped for proper feel. The handling qualities were evaluated in a high fidelity, manned simulation of the system. The QFT design provided level 1 handling qualities per the specifications in the pitch channel. It did not provide level 1 handling qualities in the lateral channel, but the design requires minor modification to meet level 1.
DTIC
F-16 Aircraft; Simulation; Design Analysis; Control Systems Design; Flight Simulation; Aircraft Configurations; Flight Control; Jet Aircraft

19980201579 Analytical Services and Materials, Inc., Hampton, VA USA
Verification of Life Prediction Methods for Aging Aircraft Structures ***Final Report, 1 Apr. 1996 - 31 Mar. 1997***
Elsner, J. H., Analytical Services and Materials, Inc., USA; Boyd, K. L., Analytical Services and Materials, Inc., USA; Harter, J. A., Analytical Services and Materials, Inc., USA; Aug. 1997; 43p; In English
Contract(s)/Grant(s): F33615-94-D-3212; AF Proj. 2401
Report No.(s): AD-A339094; WL-TR-97-3107; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this research is to verify methodologies for AFGROW developed in conjunction with Delivery Order 0006, Contract F33615-94-D-3212. The methodologies, which pertain to aging aircraft, include bonded repair of metallic structures, widespread fatigue damage, stress level effects on crack growth and load sequence effects on crack growth. AFGROW is a fatigue crack growth prediction code developed by Analytical Services and Materials, Inc. and the Air Force. This research is necessitated by the growing need to keep current aircraft in service well beyond their normal design lives. When cracks are discovered in inspection the components must be either repaired or replaced. In most instances it is not economically feasible to replace entire components. Therefore, repairing the damaged areas is both preferred and critical. Additionally, repairs must be made quickly so the aircraft may be returned to service as soon as possible. Also, it is important to be able to model and predict fatigue crack growth behavior (exposed to various spectrum loading situations) that were not accounted for when determining a component's design life.
DTIC
Proving; Procedures; Fatigue (Materials); Aging (Materials); Prediction Analysis Techniques; Life (Durability)

19980201664 Wright Lab., Control Systems Development Branch, Wright-Patterson AFB, OH USA

Emerging Military Unmanned Air Vehicle System Concepts

Ramage, James K., Wright Lab., USA; Dec. 1997; 10p; In English; Also announced as 19980201657; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Unmanned Air Vehicle (UAV) systems are evolving with unprecedented mission area capabilities. Next generation military UAV's offer the potential for achieving a revolutionary reduction in the total cost of conducting tactical air warfare. Exploiting the full potential of UAV's in terms of overall cost and mission capability is highly dependent on the ability to safely operate quasi-autonomously in a dynamic multi-vehicle combat environment. Continuous remotely piloted techniques and fixed pre-determined way point flight trajectory systems of the past, are giving way to more highly automated vehicle management systems to provide variable system integrity and user confidence. Development of multi-dimensional guidance and control, adaptive agent based flight management and information fusion technologies represent the essential enabling elements to permit safe and effective operational employment of unmanned strike aircraft. As the military community develops and matures the UAV technology base, commercial spin-off applications are also beginning to emerge, e.g. law enforcement, ground traffic surveillance, maritime patrols, and wide area telecommunication. The combined commercial and military UAV application trend will have serious implications with respect to civil airspace usage and associated vehicle certification requirements and standards.
Author

Military Technology; Pilotless Aircraft; Remotely Piloted Vehicles; Flight Management Systems; Automatic Flight Control; Systems Integration

07
AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

19980197318 NASA Lewis Research Center, Cleveland, OH USA

A Modified Through-Flow Wave Rotor Cycle with Combustor Bypass Ducts

Paxson Daniel E., NASA Lewis Research Center, USA; Nalim, M. Razi, NASA Lewis Research Center, USA; Apr. 1998; 12p; In English; 33rd; Joint Propulsion Conference and Exhibit, 6-9 Jul. 1997, Seattle, WA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 523-26-33

Report No.(s): NASA/TM-1998-206971; NAS 1.15:206971; E-10987-1; AIAA Paper 97-3140; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A wave rotor cycle is described which avoids the inherent problem of combustor exhaust gas recirculation (EGR) found in four-port, through-flow wave rotor cycles currently under consideration for topping gas turbine engines. The recirculated hot gas is eliminated by the judicious placement of a bypass duct which transfers gas from one end of the rotor to the other. The resulting cycle, when analyzed numerically, yields an absolute mean rotor temperature 18% below the already impressive value of the conventional four-port cycle (approximately the turbine inlet temperature). The absolute temperature of the gas leading to the combustor is also reduced from the conventional four-port design by 22%. The overall design point pressure ratio of this new bypass cycle is approximately the same as the conventional four-port cycle. This paper will describe the EGR problem and the bypass cycle solution including relevant wave diagrams. Performance estimates of design and off-design operation of a specific wave rotor will be presented. The results were obtained using a one-dimensional numerical simulation and design code.
Author

Wave Rotors; Combustion Chambers; Exhaust Gases; Gas Turbine Engines

19980197323 NASA Lewis Research Center, Cleveland, OH USA

Application of Pressure Sensitive Paint to Confined Flow at Mach Number 2.5

Lepicovsky, J., NYMA, Inc., USA; Bencic, T. J., NASA Lewis Research Center, USA; Bruckner, R. J., NASA Lewis Research Center, USA; May 1998; 17p; In English; 33rd; Joint Propulsion Conference, 6-9 Jul. 1997, Seattle, WA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): NAS3-27186; RTOP 523-26-13

Report No.(s): NASA/TM-1998-107527; E-10842; NAS 1.15:107527; AIAA Paper 97-3214; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Pressure sensitive paint (PSP) is a novel technology that is being used frequently in external aerodynamics. For internal flows in narrow channels, and applications at elevated nonuniform temperatures, however, there are still unresolved problems that complicate the procedures for calibrating PSP signals. To address some of these problems, investigations were carried out in a narrow channel with supersonic flows of Mach 2.5. The first set of tests focused on the distribution of the wall pressure in the diverging section of the test channel downstream of the nozzle throat. The second set dealt with the distribution of wall static pressure due to the shock/wall interaction caused by a 25 deg. wedge in the constant Mach number part of the test section. In addition, the total temperature of the flow was varied to assess the effects of temperature on the PSP signal. Finally, contamination of the pressure field data, caused by internal reflection of the PSP signal in a narrow channel, was demonstrated. The local wall pressures were measured with static taps, and the wall pressure distributions were acquired by using PSP. The PSP results gave excellent qualitative impressions of the pressure field investigated. However, the quantitative results, specifically the accuracy of the PSP data in narrow channels, show that improvements need to be made in the calibration procedures, particularly for heated flows. In the cases investigated, the experimental error had a standard deviation of +/- 8.0% for the unheated flow, and +/- 16.0% for the heated flow, at an average pressure of 11 kpa.
Author
Wall Pressure; Supersonic Flow; Aerodynamics; Paints; Pressure Distribution; Shock Wave Interaction; Static Pressure

19980200885 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Improving Algorithmic Efficiency of Aircraft Engine Design for Optimal Mission Performance
Millhouse, Paul T., Air Force Inst. of Tech., USA; Mar. 1998; 153p; In English
Report No.(s): AD-A341915; AFIT/GOR/ENY/98M-02; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
Automated techniques for selecting jet engines that minimize overall fuel consumption for a given aircraft mission have recently been developed. However, the current techniques lack the efficiency required by Wright Laboratories. Two noted dependencies between turbine engine fan pressure ratio, bypass ratio, high pressure compressor pressure ratio and overall engine mass flow allows for a reduction in the number of independent design variables searched in the optimization process. Additionally, through the use of spatial statistics (specifically kriging estimation), it is possible to significantly reduce the number of time consuming response function evaluations required to obtain an optimal combination of engine parameters. A micro Genetic Algorithm (microGA) is employed to perform the non linear optimization process with these two computation saving techniques. Optimal engine solutions were obtained in 25 percent of the time required by previous automated search algorithms.
DTIC
Fuel Consumption; Aircraft Design; Genetic Algorithms; Engine Design; Computation; Aircraft Engines

19980201284 Air Force Research Lab., Propulsion Directorate, Wright-Patterson AFB, OH USA
FY98 Aero Propulsion & Power Technology Area Plan ***Final Report, 1 Oct. 1997 - 30 Sep. 1998***
Nov. 1997; 38p; In English
Contract(s)/Grant(s): AF Proj. 9993
Report No.(s): AD-A338965; AFRL-PR-WP-TR-1998-2000; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The Aero Propulsion and Power Technology Area is responsible for developing air breathing propulsion and power technology for Air Force use. Besides developing new technologies, product centers are supported by helping acquire systems and providing expertise to help solve developmental problems. current research and development includes aircraft gas turbine engines (components, gas generators, technology demonstrator engines, fuels and lubricants), missile propulsion, solid fuel ramjets, ducted rockets, and small turbine engines, aircraft and missile power (electrical and mechanical power generation, conditioning and distribution, energy storage, and thermal management), and plasma physics.
DTIC
Air Breathing Engines; Propulsion System Configurations; Power Conditioning

19980201453 Akron Univ., Dept. of Electrical Engineering, Akron, OH USA
A Method for Generating Reduced-Order Linear Models of Multidimensional Supersonic Inlets ***Final Report***
Chicatelli, Amy, Akron Univ., USA; Hartley, Tom T., Akron Univ., USA; May 1998; 80p; In English
Contract(s)/Grant(s): NCC3-508; RTOP 519-30-53
Report No.(s): NASA/CR-1998-207405; E-11164; NAS 1.26:207405; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
Simulation of high speed propulsion systems may be divided into two categories, nonlinear and linear. The nonlinear simulations are usually based on multidimensional computational fluid dynamics (CFD) methodologies and tend to provide high resolution results that show the fine detail of the flow. Consequently, these simulations are large, numerically intensive, and run much

slower than real-time. ne linear simulations are usually based on large lumping techniques that are linearized about a steady-state operating condition. These simplistic models often run at or near real-time but do not always capture the detailed dynamics of the plant. Under a grant sponsored by the NASA Lewis Research Center, Cleveland, Ohio, a new method has been developed that can be used to generate improved linear models for control design from multidimensional steady-state CFD results. This CFD-based linear modeling technique provides a small perturbation model that can be used for control applications and real-time simulations. It is important to note the utility of the modeling procedure; all that is needed to obtain a linear model of the propulsion system is the geometry and steady-state operating conditions from a multidimensional CFD simulation or experiment. This research represents a beginning step in establishing a bridge between the controls discipline and the CFD discipline so that the control engineer is able to effectively use multidimensional CFD results in control system design and analysis.
Author
Supersonic Inlets; Computational Fluid Dynamics; Computerized Simulation; Propulsion System Configurations; Propulsion System Performance

19980201481 North Carolina Agricultural and Technical State Univ., Mechanical Engineering Dept., Greensboro, NC USA
Aerothermo-Structural Analysis of Low Cost Composite Nozzle/Inlet Components
Cozart, Aaron, North Carolina Agricultural and Technical State Univ., USA; Shivakumar, Kunigal N., North Carolina Agricultural and Technical State Univ., USA; HBCUs Research Conference Agenda and Abstracts; Apr. 1998, pp. 31; In English; Also announced as 19980201458; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche; Abstract Only; Abstract Only

Objectives of the research are to develop an integrated aerodynamic, thermal, and structural analysis code for design of aircraft engine components, such as, nozzles and inlets made of textile composites. There can be two approaches to solve these types of problems. One is a multiphysics approach wherein the problem is formulated as a single unified equation involving various disciplines. This equation is solved simultaneously. This approach is attractive, but it is difficult to solve. The second approach is the traditional approach, wherein different models were used in each of the areas and solved independently. The solution from one analysis is mapped to the other and the change of configuration and/or conditions are compared. The analysis is iterated until convergence is attained. Such an approach is demonstrated with an example of a rocket nozzle made of braided ablative composite material. The lecture highlights the complexities and tediousness involved in this approach. To eliminate some of these problems an integrated analytical model for engine components will be developed. This utilizes the existing best codes that were developed by NASA and its contractors for flow, thermal, and structural analyses and integrates them into one using a graphical user interface. Author
Structural Analysis; Thermal Analysis; Mathematical Models; Graphical User Interface; Engine Parts; Engine Inlets; Nozzle Design

19980201765 Georgia Inst. of Tech., Industrial and Systems Engineering, Atlanta, GA USA
Static and Dynamic Balance of Rotor Stacks ***Final Report, 1 Jan. 1995 - 31 Dec. 1997***
Bartholdi, John J., III, Georgia Inst. of Tech., USA; Vande Vate, John H., Georgia Inst. of Tech., USA; Feb. 28, 1998; 8p; In English
Contract(s)/Grant(s): F49620-95-1-0121
Report No.(s): AD-A340085; AFRL-SR-BL-TR-98-0213; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Heuristic algorithms to guide assembly of jet engine rotors to reduce static unbalance have been devised and analyzed. DTIC
Jet Engines; Static Stability; Dynamic Stability; Rotors; Stacks

08
AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

19980200805 Naval Postgraduate School, Monterey, CA USA
On Integrated Plant, Control and Guidance Design
Hallberg, Eric N., Naval Postgraduate School, USA; Sep. 1997; 210p; In English
Report No.(s): AD-A341957; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

Two theoretical methods and the development of a guidance, navigation and control rapid protoyping system address the issue of considering the integral participation of feedback early in the design process. The first method addresses the problem of sizing the horizontal tail on a statically unstable transport aircraft. Dynamic constraints including recovery from a severe angle of attack excursion and penetration of a vertical wind shear are formulated in terms of the solution to a convex minimization problem utiliz-

ing LMIs and used to size the horizontal control surfaces. The second method addresses the problem of tracking inertial trajectories with applications for unmanned air vehicles. This problem is posed and solved within the framework of gain scheduled control theory leading to a new technique for integrated guidance and control systems with guaranteed performance and robustness properties. Finally, a rapid prototyping system for the flight test of GNC algorithms for unmanned air vehicles is designed that affords a small team the ability to quickly take a new concept in guidance, navigation and control from initial conception to flight test.
DTIC
Air Navigation; Inertial Navigation; Plant Design; Flight Control; Design Analysis; Tail Assemblies

19980200950 Utah Univ., Salt Lake City, UT USA
Robust Adaptive Algorithms for Reconfigurable Flight Control Systems ***Final Report***
Mar. 24, 1998; 93p; In English
Contract(s)/Grant(s): F49620-95-1-0341
Report No.(s): AD-A342465; AFRL-SR-BL-TR-98-0310; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The objective of the project was to develop adaptive algorithms for application to reconfigurable flight control. An emphasis of the research was on robustness issues related to unmodelled dynamics and actuator saturation. Areas of investigation included: (1) the development of real time parameter identification algorithms for situations where the information content of the data varies significantly over time; (2) the incorporation of integral compensation in adaptive control algorithms with bias cancellation capabilities; and (3) the design of command limiting methods for the alleviation of problems associated with actuator saturation. The results showed that relatively simple multivariable adaptive control algorithms could be designed that were effective in providing flight control reconfiguration over a wide range of flight conditions. A detailed fighter aircraft model was used to evaluate the performance of the reconfigurable control laws in simulations.
DTIC
Control Theory; Robustness (Mathematics); Adaptive Control; Fighter Aircraft; Aircraft Models; Multivariable Control

19980201173 Stanford Univ., Joint Inst. for Aeronautics and Acoustics, Stanford, CA USA
Experiments in Aircraft Roll-Yaw Control using Forebody Tangential Blowing
Pedreiro, Nelson, Stanford Univ., USA; Nov. 1997; 187p; In English
Contract(s)/Grant(s): NCC2-55
Report No.(s): NASA/CR-97-208349; NAS 1.26:208349; JIAA-TR-120; Copyright Waived (NASA); Avail: CASI; A09, Hardcopy; A02, Microfiche

Advantages of flight at high angles of attack include increased maneuverability and lift capabilities. These are beneficial not only for fighter aircraft, but also for future supersonic and hypersonic transport aircraft during take-off and landing. At high angles of attack the aerodynamics of the vehicle are dominated by separation, vortex shedding and possibly vortex breakdown. These phenomena severely compromise the effectiveness of conventional control surfaces. As a result, controlled flight at high angles of attack is not feasible for current aircraft configurations. Alternate means to augment the control of the vehicle at these flight regimes are therefore necessary. The present work investigates the augmentation of an aircraft flight control system by the injection of a thin sheet of air tangentially to the forebody of the vehicle. This method, known as Forebody Tangential Blowing (FTB), has been proposed as an effective means of increasing the controllability of aircraft at high angles of attack. The idea is based on the fact that a small amount of air is sufficient to change the separation lines on the forebody. As a consequence, the strength and position of the vortices are altered causing a change on the aerodynamic loads. Although a very effective actuator, forebody tangential blowing is also highly non-linear which makes its use for aircraft control very difficult. In this work, the feasibility of using FTB to control the roll-yaw motion of a wind tunnel model was demonstrated both through simulations and experimentally. The wind tunnel model used in the experiments consists of a wing-body configuration incorporating a delta wing with 70-degree sweep angle and a cone-cylinder fuselage. The model is equipped with forebody slots through which blowing is applied. There are no movable control surfaces, therefore blowing is the only form of actuation. Experiments were conducted at a nominal angle of attack of 45 degrees. A unique apparatus that constrains the model to two degrees-of-freedom, roll and yaw, was designed and built. The apparatus was used to conduct dynamic experiments which showed that the system was unstable, its natural motion divergent. A model for the unsteady aerodynamic loads was developed based on the basic physics of the flow and results from flow visualization experiments. Parameters of the aerodynamic model were identified from experimental data. The model was validated using data from dynamic experiments. The aerodynamic model completes the equations of motion of the system which were used in the design of control laws using blowing as the only actuator. The unsteady aerodynamic model was implemented as part of the real-time vehicle control system. A control strategy using asymmetric blowing was demonstrated experimentally. A discrete vortex method was developed to help understand the main physics of the flow. The method correctly captures the interactions between forebody and wing vortices. Moreover, the trends in static loads and flow structure are correctly represented. Flow

visualization results revealed the vortical structure of the flow to be asymmetric even for symmetric flight conditions. The effects of blowing, and roll and yaw angles on the flow structure were determined. It is shown that superimposing symmetric and asymmetric blowing has a linearizing effect on the actuator characteristics. Transient responses of roll and yaw moments to step input blowing were characterized, and their differences were explained based on the physical mechanisms through which these loads are generated.
Author
Roll; Yaw; Forebodies; Flight Control; Tangential Blowing; Vortices; Aircraft Control; Control Simulation; Angle of Attack; Flow Visualization; Wind Tunnel Models; Wind Tunnel Tests; Aerodynamic Characteristics; Mathematical Models; Computerized Simulation

19980201452 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Flight Test and Handling Qualities Analysis of a Longitudinal Flight Control System Using Multiobjective Techniques
Anderson, John R., Air Force Inst. of Tech., USA; Mar. 1998; 216p; In English
Contract(s)/Grant(s): M96J
Report No.(s): AD-A342205; AFIT/GAE/ENY/98M-01; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

This thesis addresses the application of optimal, multiobjective control theory to flight control design for the approach and landing phase of flight. Five flight control systems were designed using classical, H2, H infinity, and Mixed H2/H infinity methods. The MATLAB(TM) MUTOOLS(TM) and AFIT MXTOOLS toolboxes were used to produce the optimal, multiobjective designs. These designs were implemented for flight test on the Calspan VSS I Learjet, simulating the unstable longitudinal dynamics of an F-16 type aircraft. A limited handling qualities investigation was performed. Model following was used in the design phase to meet handling qualities specifications. The designs were successfully implemented and verified on the Calspan Learjet prior to flight test. An unmodeled aircraft mode was discovered just prior to flight test that made three of the designs slightly unstable. However, all of the designs achieved Level II or better Cooper-Harper handling qualities ratings for the landing tasks performed illustrating that the optimal multiobjective methods used can give acceptable or better handling qualities.
DTIC
Flight Control; Flight Tests; Lear Jet Aircraft; F-16 Aircraft; Control Systems Design; Optimal Control; Control Theory

09
RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

19980197482 Galaxy Scientific Corp., Egg Harbor Township, NJ USA
Impact of New Large Aircraft on Airport Design ***Final Report***
Patterson, J. W., Galaxy Scientific Corp., USA; Mar. 1998; 85p; In English
Contract(s)/Grant(s): DTFA03-95-D-00019
Report No.(s): AD-A342894; DOT/FAA/AR-97/26; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The object of this project is to assess the impact of the introduction of proposed new large aircraft (NLA) on current airport design standards and administered by the Federal Aviation Administration (FAA). This report identifies several key design and operational characteristics of proposed NLA that will need to be taken into consideration before the aircraft are introduced into the current airport environment. Specific elements of airport planning and design that may be affected by these changes in aircraft characteristics have been identified to assist airport planners and the FAA in preparing for the NLA's arrival. In addition, a 20-year projection of NLA development and a qualitative cost and compatibility assessment of introducing NLA's at a sample airport that currently serves the Boeing 747 are included in this final report. Throughout this report, references are made to current airport design Advisory Circulars that will require modifications to reflect the introduction of NLA. Some changes will include simple additions of aircraft performance data, while others will require incorporation of new standards or recommendations that specifically address NLA. Airports expecting to serve NLA will be required to modify their existing facilities to meet the design criteria of airport design group VI. Recommendations are made to revise the applicable airport design standards, continue investigating the demands of NLA, and to determine their affects on the individual airports that are expecting to serve them.
DTIC
Airport Planning; Boeing 747 Aircraft; Design Analysis; Aircraft Design

19980200988 NASA Langley Research Center, Hampton, VA USA

Recent Productivity Improvements to the National Transonic Facility

Popernack, Thomas G., Jr., NASA Langley Research Center, USA; Sydnor, George H., NASA Langley Research Center, USA; 1998; 12p; In English; 20th; Advanced Measurement and Ground Testing Technology Conference, 15-18 Jun. 1998, Albuquerque, NM, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): NASA/TM-1998-207981; NAS 1.15:207981; AIAA Paper 97-2704; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Productivity gains have recently been made at the National Transonic Facility wind tunnel at NASA Langley Research Center. A team was assigned to assess and set productivity goals to achieve the desired operating cost and output of the facility. Simulations have been developed to show the sensitivity of selected process productivity improvements in critical areas to reduce overall test cycle times. The improvements consist of an expanded liquid nitrogen storage system, a new fan drive, a new tunnel vent stack heater, replacement of programmable logic controllers, an increased data communications speed, automated test sequencing, and a faster model changeout system. Where possible, quantifiable results of these improvements are presented. Results show that in most cases, improvements meet the productivity gains predicted by the simulations.

Author

Improvement; Operating Costs; Transonic Wind Tunnels; Computerized Simulation; Productivity; Production Engineering

19980201239 Federal Data Corp., Brook Park, OH USA

Flow Quality and Operational Enhancements in the NASA Lewis 8- by 6-Foot Supersonic Wind Tunnel ***Final Report***

Arrington, E. Allen, Federal Data Corp., USA; Gonsalez, Jose C., Federal Data Corp., USA; Becks, Edward A., Federal Data Corp., USA; Jun. 1998; 16p; In English; 20th; Advanced Measurement and Ground Testing Technology, 15-18 Jun. 1998, Albuquerque, NM, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NAS3-27185; RTOP 505-62-82

Report No.(s): NASA/CR-1998-207930; E-11193; NAS 1.26:207930; AIAA Paper 98-2706; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Improving wind tunnel test productivity and data quality are two ongoing efforts at the NASA Lewis Research Center. Over the past 5 years, several flow quality and operational improvements have been made in the NASA Lewis 8- by 6-Foot Supersonic Wind Tunnel, including the addition of turbulence-reduction screens and a flow-straightening honey-comb, and enhancements to the tunnel drive system. Extensive flow quality and calibration measurements were made prior to and following the facility improvements in order to gauge their effectiveness. The data show that the flow quality in the test section improved for all operating conditions. Subsequent changes to the drive system operation allowed for the expansion of the facility Mach number range downward into the low subsonic regime, making the facility more versatile.

Author

Wind Tunnels; Supersonic Wind Tunnels; Measuring Instruments; Mach Number; Calibrating

19980201523 Science Applications International Corp., CSM Div., Arlington, VA USA

Six Heliport Case Studies ***Final Report***

Peisen, Deborah J., Science Applications International Corp., USA; Winick, Robert M., Winick (Robert M.), USA; Berardo, Stephen V., Hoyle, Tanner and Associates, USA; Ferguson, Samuel W., EMA, USA; Nov. 1997; 132p; In English

Contract(s)/Grant(s): DTFA01-93-C-00030

Report No.(s): AD-A340421; DOT/FAA/ND-97/1; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Over the years, one of the main concerns of the vertical flight industry has been heliport development. The record shows that most proposed heliports are never built, and that even a heliport that has been fully operational for years can be closed due to changing community priorities. This report evaluates the dynamics of heliport development and operation in order to achieve greater success rate in the future through the case study investigation of six heliports that have both succeeded and failed. The heliports studied are: Houston Central Business District Heliport, Houston Texas; E.34th Street Heliport, New York, New York; Garland HeliPlex, Garland, Texas; Annapolis Heliport, Annapolis, Maryland; Boston City Heliport, Boston, Massachusetts; and Cobo Hall Heliport, Detroit, Michigan. This study is a follow-on to two previous studies for the Federal Aviation Administration (FAA): "Four Urban Heliport Case Studies," (reference 1) completed in 1988, and "Heliport/Vertiport Implementation Process - Case Studies" (reference 2) completed in 1996. The first study endeavored to understand what causes a heliport to succeed or fail. The second investigated why heliports succeed or fail in the implementation process at the local government level and recommended ways to improve the success rate.

DTIC

Evaluation; Product Development; Commerce; Failure; Helicopters

10
ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

19980201302 Naval Postgraduate School, Monterey, CA USA
Evaluation of Potential Changes to the Space Shuttle Orbiter's Flight Control System to Increase Directional Control During Post Landing Rollout
Ham, Linda J., Naval Postgraduate School, USA; Sep. 1997; 130p; In English
Report No.(s): AD-A340494; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Space Shuttle Orbiter landings indicate both long term directional instability and the potential for pilot induced oscillations during landing and rollout before nosewheel touchdown. The Orbiter's Flight Control System requires improvements to increase directional control in the two points stance (after main gear touchdown with the nose in the air). A number of modifications are proposed to improve directional control. This thesis describes the control deficiency, potential improvements to the Flight Control System (FCS), and evaluates a number of these improvements. The evaluation was performed by modeling the Orbiter's postlanding lateral/directional control laws using a commercially available engineering software package known as MATLAB 5.0. Directional control of the Orbiter was evaluated with and without the proposed modification to obtain a comparison of control response. Initial evaluation of future Orbiter FCS modifications could be performed using commercially available engineering software packages such as MATLAB; rather than costly full-up Orbiter simulators. A low cost initial evaluation of changes may save NASA resources.
DTIC
Space Shuttles; Landing Gear; Space Shuttle Orbiters; Applications Programs (Computers); Flight Control

19980201691 Canadian Space Agency, Saint Hubert, Quebec Canada
RADARSAT time rate of mean semi-major axis due to drag
Marandi, Said R., Canadian Space Agency, Canada; AAS/GSFC 13th International Symposium on Space Flight Dynamics; May 1998; Volume 2, pp. 709-714; In English; Also announced as 19980201678
Report No.(s): AAS Paper 98-358; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

A model of time rate of the mean semi-major axis due to radiation drag versus day of year and orientation of RADARSAT is developed. This model takes into account the periodic shadowing of the satellite by the earth during the summer months. Through use of this model, the flight orbital data from 1996-98, and a number of assumptions, the following parameters are extracted via a least squares technique: (i) the aerodynamic drag formed only about 39% of the net drag on the satellite in 1996; (ii) 21% of the radiation on the cell side of the solar array was reflected. Four pieces of evidence are offered for the accuracy of the tuned model: (1) the flight measured time rate of mean semi-major axis prior, during and after a ten day solar array articulation maneuver versus the predictions of the tuned model, (2) the vendor absorptance values for the cell side of the solar array versus the deduced reflected portion of the incident radiation, (3) the increase of the average aerodynamic drag from year 1996 to 1997 deduced from this model versus the rise of the solar flux at 10.7 cm wave length, and (4) qualitative agreement between the model and the measured data during 1996-1998. Aside from the operational significance of (i), once proven accurate by accounting for the remaining fuel of RADARSAT in year 2001 and the effect of solar cycles on the atmospheric drag, this intelligence, markedly different from the values estimated by previous studies, opens the door to the following consideration: an effective use of radiation pressure may be made in the design of satellites with large surface to mass ratio to reduce the needed fuel for periodic orbit corrections.
Author
Aerodynamic Drag; Radarsat; Flight Mechanics; Satellite Orientation; Satellite Attitude Control; Satellite Tracking; Mathematical Models

19980201693 Space Mission Control Center, Korolyov, Russia
Flight dynamic designing of manned return space vehicle for hyperbolic entry
Ivanov, N. M., Space Mission Control Center, Russia; Kazakov, M. N., Space Mission Control Center, Russia; Rumynskiy, A. N., Space Mission Control Center, Russia; Sobolevskiy, V. G., Space Mission Control Center, Russia; Udaloy, V. A., Space Mission Control Center, Russia; AAS/GSFC 13th International Symposium on Space Flight Dynamics; May 1998; Volume 2, pp. 727-740; In English; Also announced as 19980201678
Report No.(s): AAS Paper 98-361; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The paper presents materials on development of a future manned returned space vehicle included into a complex for the Martian mission. The basic points of the developed aerothermodynamic and flight dynamic method for designing of the unwinged returned vehicle performing an entry to the Earth atmosphere at hyperbolic velocities are presented. The results of the comparative thermal and mass analysis are given for three unwinged returned vehicles and for the entry velocities 13-17 km/s, longitudinal ranges of descent 3000-5000 km (providing the accuracy of landing within 1 km), satisfying the temperature constraint at a characteristic point on the windward surface of the vehicle and also providing admissible g-loads for the crew (taking into account the 'withstandability' factor).
Author
Aerothermodynamics; Spacecraft Construction Materials; Spacecraft Design; Manned Spacecraft; Hypersonic Reentry; Aerodynamic Heating; Flight Characteristics

19980201695 Officine Galileo S.p.A., Alenia Difesa, Florence, Italy
Autonomous star tracker: performance versus cost effective A-STR
Landi, A., Officine Galileo S.p.A., Italy; Procopio, D., Officine Galileo S.p.A., Italy; Lucarini, M., Officine Galileo S.p.A., Italy; AAS/GSFC 13th International Symposium on Space Flight Dynamics; May 1998; Volume 2, pp. 755; In English; Also announced as 19980201678
Report No.(s): AAS Paper 98-363; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche; Abstract Only; Abstract Only

As an evolution of activities performed in the frame of an ESTEC contract for the development and realization of an autonomous star sensor for interplanetary and scientific mission, OG is now developing a compact autonomous star tracker useful for commercial applications where reduced mass, power consumption, and recurring cost are driving requirements, rather than accuracy. Through proper on-board star catalogues and pattern recognition and attitude estimation algorithms, the sensor is capable to quickly determine attitude and rate of S/C with respect to an inertial reference frame without any a priori attitude knowledge. The sensor is designed to allow an updating rate of 10 Hz (or higher) to be competitive with the faster sensor on board of a S/C (i.e. gyro) and then to be used as part of a gyroless attitude control system. New Electronic packaging technology and VLSI components are used to reduce electronic volume to the minimum extent. This paper presents the description of the sensor H/W and S/W, a summary of the functionality and the performance analysis as obtained via a high fidelity simulator.
Author
Star Trackers; Flight Instruments; Spacecraft Guidance; Navigation Instruments; Astroguide Navigation System; Attitude Control; Costs; Astronomical Catalogs; Systems Engineering

19980201697 Hughes Telecommunications, El Segundo, CA USA
Probability analysis for spacecraft attitude acquisition using star pattern match algorithm
Didinsky, Garry, Hughes Telecommunications, USA; Wu, Andy, Hughes Aircraft Co., USA; AAS/GSFC 13th International Symposium on Space Flight Dynamics; May 1998; Volume 2, pp. 773-774; In English; Also announced as 19980201678
Report No.(s): AAS Paper 98-365; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Star trackers have recently been used to determine spacecraft attitude by identifying and matching the observed stars in the tracker field of view (FOV) against onboard catalog stars. Many algorithms to perform initial attitude acquisition using star sighting data have been developed for autonomous attitude determination. However, none of these papers provides analytical methods to predict the attitude acquisition algorithm performance. This paper presents a probabilistic model that can accurately predict the probability of a successful attitude acquisition using star pattern match algorithms. A lower bound of successful attitude acquisition probability is also derived in the paper to assess the worst case performance. Statistics generated from Monte Carlo simulations are used to validate the derived probabilistic model. The results demonstrate the usefulness of the probabilistic model for performing system performance trades against many attitude acquisition design parameters such as star tracker FOV, maximum tracked stars, star magnitude sensitivity and accuracy, star position accuracy, and number of catalog stars.
Author
Satellite Attitude Control; Star Trackers; Probability Theory; Systems Engineering; Algorithms; Astroguide Navigation System; Navigation Instruments; Systems Analysis; Flight Instruments

19980201698 Instituto Nacional de Pesquisas Espacias, Div. of Space Mechanics and Control, Sao Jose dos Campos, Brazil
Star identification for three-axis attitude estimation of French-Brazilian scientific micro-satellite
Lopes, Roberto V. F., Instituto Nacional de Pesquisas Espacias, Brazil; Carvalho, Gustavo B., Instituto Nacional de Pesquisas Espacias, Brazil; Silva, Adenilson R., Instituto Nacional de Pesquisas Espacias, Brazil; AAS/GSFC 13th International Symposium on Space Flight Dynamics; May 1998; Volume 2, pp. 775-789; In English; Also announced as 19980201678
Contract(s)/Grant(s): CNPq-300388/95-0

Report No.(s): AAS Paper 98-366; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper investigates full sky star identification methods envisaging their application to attitude determination of the French-Brazilian scientific micro-satellite. A statistical analysis gives a suitable framework to select and adapt an algorithm based on the relationship between star sensor specification and the achievable star identification confidence level under the mission constraints. Attitude determination global performance is presented for a one year long digital simulation, which is intended to give subside to the AOCS design.

Author

Star Trackers; Flight Instruments; Scientific Satellites; Algorithms; Satellite Attitude Control; Celestial Navigation

19980201704 National Space Development Agency, Tsukuba, Japan

Reentry prediction method using plural two line elements

Konno, Hiroyuki, National Space Development Agency, Japan; Tajima, Toru, National Space Development Agency, Japan; Hirota, Masao, National Space Development Agency, Japan; AAS/GSFC 13th International Symposium on Space Flight Dynamics; May 1998; Volume 2, pp. 857-870; In English; Also announced as 19980201678

Report No.(s): AAS Paper 98-372; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The uncontrolled reentry of space objects is one of the serious problems that the space agencies in the world face. This paper presents a new reentry prediction method, which estimates the reentry time using multiple sets of orbital information and an error-propagation model. In the low-altitude orbit, the dominant perturbing force for object's motion is air drag. Analyzing how the air drag affects the accuracy of the orbit propagation, we constructed an error-propagation model. Combining the multiple orbital information with this model, this method estimates the optimal air drag and predicts a reentry time accurately. to demonstrate the performance of this method, a reentry prediction experiment was performed. The experimental prediction took an example of the Chinese satellite FSW1 that actually reentered on 12 March, 1996. Results show that the method can provide accurate predictions of reentry time.

Author

Uncontrolled Reentry (Spacecraft); Performance Prediction; Prediction Analysis Techniques; Orbital Maneuvers; Aerodynamic Drag; Orbital Mechanics; Mathematical Models; Error Analysis; Flight Time

19980201706 Lockheed Martin Space Mission Systems, Seabrook, MD USA

Solar torque compensation determination system for the GOES I-M series weather satellites

DeGumbia, Jonathan D., Lockheed Martin Space Mission Systems, USA; Tsui, Yo-Kung J., National Oceanic and Atmospheric Administration, USA; AAS/GSFC 13th International Symposium on Space Flight Dynamics; May 1998; Volume 2, pp. 887-898; In English; Also announced as 19980201678

Report No.(s): ASS Paper 98-374; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The Geostationary Operational Environmental Satellite [GOES] I-M series geostationary, three-axis stabilized, weather satellites utilize an optically reflective panel known as a trim tab to minimize the solar pressure imbalance caused by optical and geometric differences between the north panel mounted solar sail and the south panel mounted solar array. The trim tab is mounted on the south end of the solar array and is adjustable rotationally through one degree of freedom via a stepping motor mounted at the hinge point. Daily trim tab adjustments serve to balance the solar pressure throughout the Sun's annual declination cycle and compensate for changes in center of mass location and optical properties throughout the spacecraft life. This is necessary to minimize the requirements on thruster firings and magnetic torquer coils used to relieve momentum. Since the launch of the first spacecraft of this series on April 13, 1994, the trim tab daily slew commanding system has undergone several redesigns. The current method of determining the daily slews is an open-loop system requiring recalculation every 2 to 3 days. The inaccuracy of this system and its reliance on frequent engineering interaction has spawned a need for a self-contained method of control with improved performance. This new method will utilize the existing and proven performance analysis routine and will have the ability to be integrated into the current ground system software with minimal effort. This paper describes the closed-loop trim tab daily slew determination algorithm derived through these efforts, summarizes a proposed method of ground system integration, and discusses the results of initial on-orbit tests.

Author

GOES 1; Solar Activity Effects; Torque; Tabs (Control Surfaces); Satellite Attitude Control; Systems Integration; Spacecraft Design; Slewing; Algorithms; Feedback Control

19980201710 NASA Goddard Space Flight Center, Greenbelt, MD USA

MAP stability, design, and analysis

Ericsson-Jackson, A. J., NASA Goddard Space Flight Center, USA; Andrews, S. F., NASA Goddard Space Flight Center, USA;

O'Donnell, J. R., Jr., NASA Goddard Space Flight Center, USA; Markley, F. L., NASA Goddard Space Flight Center, USA; AAS/GSFC 13th International Symposium on Space Flight Dynamics; May 1998; Volume 2, pp. 937-951; In English; Also announced as 19980201678
Report No.(s): ASS Paper 98-378; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The Microwave Anisotropy Probe (MAP) is a follow-on to the Differential Microwave Radiometer (DMR) instrument on the Cosmic Background Explorer (COBE) spacecraft. The design and analysis of the MAP attitude control system (ACS) have been refined since work previously reported. The full spacecraft and instrument flexible model was developed in NASTRAN, and the resulting flexible modes were plotted and reduced with the Modal Significance Analysis Package (MSAP). The reduced-order model was used to perform the linear stability analysis for each control mode, the results of which are presented in this paper. Although MAP is going to a relatively disturbance-free Lissajous orbit around the Earth-Sun L(2) Lagrange point, a detailed disturbance-torque analysis is required because there are only a small number of opportunities for momentum unloading each year. Environmental torques, including solar pressure at L(2), aerodynamic and gravity gradient during phasing-loop orbits, were calculated and simulated. Thruster plume impingement torques that could affect the performance of the thruster modes were estimated and simulated, and a simple model of fuel slosh was derived to model its effect on the motion of the spacecraft. In addition, a thruster mode linear impulse controller was developed to meet the accuracy requirements of the phasing loop burns. A dynamic attitude error limiter was added to improve the performance of the ACS during large attitude slews. The result of this analysis is a stable ACS subsystem that meets all of the mission's requirements.
Author

Spacecraft Instruments; Microwave Radiometers; Flight Stability Tests; Aerodynamic Stability; Microwave Probes; Design Analysis; Satellite Attitude Control

11
CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

19980197432 Advisory Group for Aerospace Research and Development, Structures and Materials Panel, Neuilly-Sur-Seine, France

Thermal Barrier Coatings ***Les Revetements Anti-Mur de Chaleur***

Apr. 1998; 1188p; In English; 85th, 15-16 Oct. 1997, Aalborg, Denmark; Also announced as 19980197433 through 19980197449
Report No.(s): AGARD-R-823; ISBN 92-836-1073-3; Copyright Waived; Avail: CASI; A99, Hardcopy; A10, Microfiche

Thermal barrier coatings are an emerging technology which will allow either increasing the inlet turbine temperatures or on the other hand decreasing the working temperature of the metal of the blades and consequently increasing their life-time. The Workshop allowed a survey of the state of the art, a description of the existing technologies or of the technologies under development, a review of the present knowledge of damage mechanisms, including microstructural, mechanical and thermal aspects, and an account of the advantages and drawbacks of the various families as perceived by engine manufacturers and users. A final discussion was held to identify the needs for further R & D.
Author

Thermal Control Coatings; Engine Parts; Protective Coatings; Ceramic Coatings; Temperature Gradients; Aircraft Engines; Plasma Spraying; Vapor Deposition; Engine Inlets; Inlet Temperature; Temperature Control

19980197433 Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Materials and Process Dept., Villaroche, France

Thermal Barrier Coatings: The Thermal Conductivity Challenge

Alperine, S., Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France; Derrien, M., Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France; Jaslier, Y., Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France; Mevrel, R., Office National d'Etudes et de Recherches Aerospatiales, France; Thermal Barrier Coatings; Apr. 1998; 10p; In English; Also announced as 19980197432; Copyright Waived; Avail: CASI; A02, Hardcopy; A10, Microfiche

In this paper, the importance of the challenge associated with the control of the thermal conductivity of thermal barrier coatings for turbine engines hot stages is being reviewed (yttria stabilised zirconia mostly). It is firstly illustrated by the description of a practical aeronautic coated and uncoated turbine blade design exercise. The various contributions to TBC thermal conductivity are then reviewed. Their low conductivity finds its source not only in the nature of the ceramic layer (highly disordered material), but also in the morphology of the insulating layer, closely linked to its fabrication process parameters. The influence of

various factors (such as yttria content, temperature, porosity content and distribution, etc.) on the thermal conductivity is examined, largely based on a literature review. In this field of investigation, the modelling tool should allow to predict, to a certain extent, which morphology would lead to the lowest values of thermal conductivity. Eventually attempts are made to identify research domains where further understanding is needed, and to formulate several suggestions concerning possible ways to lower the thermal conductivity.
Author
Thermal Control Coatings; Yttria-Stabilized Zirconia; Turbine Engines; Turbine Blades; Thermal Conductivity; Fabrication; Protective Coatings; Ceramic Coatings; Heat Transfer; Temperature Control

19980197440 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. of Materials Research, Cologne, Germany
Processing, Characterisation, and Testing of EB-PVD Thermal Barrier Coatings
Kaysser, W. A., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Peters, M., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Fritscher, K., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Schulz, U., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Apr. 1998; 10p; In English; Also announced as 19980197432; Copyright Waived; Avail: CASI; A02, Hardcopy; A10, Microfiche

Thermal barrier coatings (TBCs) are increasingly applied to hot components in gas turbines. Contrary to plasma spraying, the electron-beam physical vapour deposition (EB-PVD) process offers the opportunity to generate coatings having a unique columnar microstructure. The main advantage of this structure is its superior tolerance against straining and thermoshock, thus giving it a major edge in lifetime. Furthermore, cooling hole closure will be prevented and the aerodynamic design of the blades will be maintained. This paper will outline the advantages of EB-PVD for the production of TBCs on rotating gas turbine components like blades and vanes. The effect of EBPVD processing parameters on the microstructural evolution and respective lifetimes of partially yttria stabilised zirconia (PYSZ) TBCs will highlight the potential of the evaporation process. Alternative stabilisers like Ce and La are looked at in terms of increase of application temperatures as well as life extension of the blades. An extended structural zone diagram for PVDis proposed incorporating the influence of substrate rotation on microstructural evolution. Finally, the limits of evaporation processing will be stressed.
Author
Thermal Control Coatings; Yttria-Stabilized Zirconia; Electron Beams; Vapor Deposition; Protective Coatings; Engine Parts; Gas Turbine Engines; Surface Properties

19980197448 Wright Lab., Aero Propulsion and Power Directorate, Wright-Patterson AFB, OH USA
The Effect of TBC Utilization in the Design of Robust Aircraft Combustors
Arana, Carlos A., Wright Lab., USA; Apr. 1998; 10p; In English; Also announced as 19980197432; Copyright Waived; Avail: CASI; A02, Hardcopy; A10, Microfiche

As performance objectives of new and derivative military engines require combustion systems to operate at higher pressures and temperatures, balancing conflicting demands of improved durability, stability, and operability becomes more difficult without technology improvements in combustor liner designs. Since combustor thermo-mechanical fatigue is currently a significant contributor to engine life cycle costs, improved structural durability must be achieved, without compromise of other combustor requirements. This paper addresses the application and verification of liner cooling schemes and their interaction with thermal barrier coatings (TBCs) for the design of robust aircraft turbine engine combustor liners to meet the above mentioned demands. An analytical investigation was conducted to determine the effect of TBCs on the average metal temperature for a full annular, semi-transpiration cooled combustor liner. The perspective is from a customer's viewpoint, a combustor liner designer who is continuously challenged to increase combustor temperature rise capability and operability for new products while maintaining cooling flow levels.
Author
Thermal Control Coatings; Aircraft Engines; Gas Turbine Engines; Combustion Chambers; Linings; Protective Coatings; Life (Durability); Thermal Fatigue; Heat Transfer; Ceramic Coatings

19980197449 Rolls-Royce Ltd., Derby, UK
Advantages/Disadvantages of Various TBC Systems as Perceived by the Engine Manufacturer
Morrell, P., Rolls-Royce Ltd., UK; Rickerby, D. S., Rolls-Royce Ltd., UK; Apr. 1998; 10p; In English; Also announced as 19980197432; Copyright Waived; Avail: CASI; A02, Hardcopy; A10, Microfiche

This paper discusses the relative advantages and disadvantages of Thermal Barrier Coatings systems (TBC's) produced by thermal spraying and electron beam PVD processing technology from a design point of view. This paper reviews the structure/property relationships for electron-beam physical vapour deposition (EB-PVD) TBC's in contrast to those of plasma sprayed

TBC's, particularly with respect to thermal conductivity, erosion resistance, and mechanical behaviour. Examples are used to show how, through the development of customized bond coat systems, the performance of TBC systems can be considerably enhanced, an important incremental step towards the ultimate goal of "designed-in TBC's".
Author
Thermal Control Coatings; Electron Beams; Vapor Deposition; Coating; Plasma Spraying; Protective Coatings; Gas Turbine Engines; Engine Parts; Performance Tests

19980200923 Army Research Lab., Aberdeen Proving Ground, MD USA
Experiments with Liquid Propellant Jet Ignition in a Ballistic Compressor ***Final Report, May - Nov. 1997***
Birk, Avi, Army Research Lab., USA; Tarczynski, Marek, Princeton Combustion Research Labs., Inc., USA; Apr. 1998; 45p; In English
Contract(s)/Grant(s): 1L1622618AH37
Report No.(s): AD-A342579; ARL-TR-1650; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes a series of tests that inaugurated the use of a ballistic compressor-based apparatus for the research of liquid propellant (L2) jet combustion. The apparatus consists of an inline ballistic compressor and LP injector. The rebound of the ballistic compressor piston was arrested, trapping 40 to 55 MPa of 750 to 8500 C argon for ignition of circular jets in a windowed test chamber. The LP jets ignited in less than 2 ms as indicated by a steep rise (ca. 3 MPa/ms) in the chamber pressure. The elevated combustion pressure ruptured a disk above 70 MPa, venting the combustion gas into the compressor's barrel. The rupture of the disk did not always stabilize the combustion pressure; with 3.5-mm jets, we obtained both quasi-steady combustion at about 80 MPa and nonsteady combustion with steep pressure rise-rate (ca. 100 MPaIms) that culminated in peak combustion pressures over 100 MPa. The nonsteady combustion occurred because LP accumulated excessively in the test chamber and burned rapidly once the combustion pressure exceeded 75 MPa. The accumulation impeded the visualization, obscuring the jet before ignition, and burned in a fireball fashion once ignited. Nevertheless, we could determine from film records that the penetration of l-mm and 3.5-mm circular XM46 jets with injection velocities over 200 m/s exceed 5 cm when the combustion pressure is below 80 MPa. Large millimeter size drops were observed burning at 80 MPA, indicating that, even at this pressure, XM46 combustion is subcritical. The operation of the piston arrest mechanism was problematic.
DTIC
Ignition; Experimentation; Air Jets; Compressors; Propellant Combustion

19980200945 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia
On Obtaining Design Allowables for Adhesives Used in the Bonded-Composite Repair of Aircraft
Chalkley, Peter, Defence Science and Technology Organisation, Australia; vandenBerg, John, Defence Science and Technology Organisation, Australia; Jan. 1998; 38p; In English
Report No.(s): AD-A342490; DSTO-TR-0608; DODA-AR-010-413; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A technique is documented, along with its experimental validation, for obtaining engineering-standard design allowables for structural adhesives used in the bonded/composite repair of aircraft structure. The design of durable bonded-composite repairs is reliant on such design allowables. It is intended that allowables obtained using this technique replace the manufacturer's brochure data that is currently in use for some adhesives. Design allowables for the most common repair adhesive - FM73 - were obtained as part of the experimental validation.
DTIC
Composite Materials; Adhesive Bonding; Aircraft Structures

19980201087 Civil Aeromedical Inst., Oklahoma City, OK USA
An Analysis of Voice Communication in a Simulated Approach Control Environment ***Final Report***
Prinzo, O. Veronika, Civil Aeromedical Inst., USA; May 1998; 36p; In English
Contract(s)/Grant(s): FAA-AM-B-96-HRR-513
Report No.(s): DOT/FAA/AM-97/17; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report consists of an analysis of simulated terminal radar approach control (TRACON) air traffic control communications. Twenty-four full performance level air traffic controllers (FPLATC) from 2 TRACON facilities participated in the simulation study. Each controller worked 2 light- and 2 heavy-traffic density scenarios for feeder and final sectors. All communications were audio recorded and transcribed verbatim by a retired FPLATC. Once transcribed, transmissions were parsed into communication elements. Each communication element was assigned a speech act category (e.g., address, instruction, request, or advisory), an aviation topic (e.g., altitude, heading, speed) and then coded for irregularities (e.g., grouping numbers together when

they should be spoken sequentially, or omitting, substituting, or adding words contrary to required phraseology) (ATSAT, Prinzo et al., 1995). The simulated communications were compared to an analysis performed on audiotapes from the same TRACON facilities. Percentages in 3 speech act categories were comparable (Instruction, 55% versus 51%; Address; 14% versus 26%; Advisory, 24% versus 18%). Detailed analyses revealed that, although there were fewer irregular communications produced during simulation, the distributions of those communication irregularities were very much the same, with the exception of aircraft call sign. The differences in those distributions were attributed to the voice recognition system; it could not recognize a call sign spoken sequentially and then restated in grouped form.
Author
Air Traffic Control; Air Traffic Controllers (Personnel); Radar Approach Control

19980201269 Yale Univ., Dept. of Chemical Engineering, New Haven, CT USA
Carbonaceous Deposit Formation from Advanced Fuels Under Supercritical Conditions ***Final Report, 15 Jan. 1994 - 14 Jul. 1997***
Pfefferle, Lisa D., Yale Univ., USA; Randolph, Theodore, Yale Univ., USA; Aug. 01, 1997; 62p; In English
Contract(s)/Grant(s): F49620-94-1-0085; AF Proj. 2303
Report No.(s): AD-A338723; AFRL-SR-BL-TR-98-0226; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Methods for measuring speed of sound and heat transfer coefficients in supercritical reacting fluids were developed and tested. These measurements were used to show that relationships for predicting supercritical fuel properties near the critical point are not valid and that in-situ measurement is important. Measurement of reaction products from the thermal stressing of MCH over a wide range of pressures and temperatures with and without oxygen contamination shows that (1) dissolved oxygen is important in the formation of products in the bulk phase (2) insoluble residues from hydrocarbons at temperatures less than 850K are likely caused by the presence of the oxygen and/or an active surface (3) the only aromatic species observed at low temperatures was toluene and naphthalene production can proceed through reactions of the benzyl radical (4) the coating of the wall of the supercritical fuel reactor with catalytically inactive titanium nitride prevented significant surface activity. Deoxygenation and passivation of metallic surfaces can be used in actual aircraft systems to reduce deposit formation. Prevention of hot-spots is also critical as rupture of the MCH ring can quickly produce benzene and higher mass aromatics.
DTIC
Supercritical Flow; Jet Engine Fuels; Supercritical Fluids; Reaction Products

19980201458 NASA Lewis Research Center, Cleveland, OH USA
HBCUs Research Conference Agenda and Abstracts
Dutta, Sunil, Compiler, NASA Lewis Research Center, USA; HBCUs Research Conference Agenda and Abstracts; Apr. 1998; 78p; In English; HBCUs Research Conference, 8-9 Apr. 1998, Cleveland, OH, USA; Sponsored by Ohio Aerospace Inst., USA; Also announced as 19980201459 through 19980201498
Contract(s)/Grant(s): RTOP 282-10-08-07
Report No.(s): NASA/CP-1998-208413; E-11138; NAS 1.55:208413; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The purpose of this Historically Black Colleges and Universities (HBCUs) Research Conference was to provide an opportunity for principal investigators and their students to present research progress reports. The abstracts included in this report indicate the range and quality of research topics such as aeropropulsion, space propulsion, space power, fluid dynamics, designs, structures and materials being funded through grants from Lewis Research Center to HBCUs. The conference generated extensive networking between students, principal investigators, Lewis technical monitors, and other Lewis researchers.
Author
Conferences; Universities; Minorities; Students; Optical Measuring Instruments; Fuel Combustion; Materials Science; Polymerization; Control; Energy Conversion; Simulation; Mathematical Models; Computer Programming; Aerodynamics; Semiconductors (Materials)

19980201536 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
Particulate Materials and Processes. A Navy Overview
Frazier, William E., Naval Air Warfare Center, USA; May 08, 1997; 28p; In English
Report No.(s): AD-A339855; NAWCADPAX--97-136-TM; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Navy is using, or is considering to use, particulate materials in a variety of applications throughout the air, surface, and submarine fleets. The applications range from aircraft engine turbine disks, which are needed to meet performance requirements,

to direct powder sprayed parts, which greatly decrease manufacturing costs. This technical memorandum will discuss many of the applications and the reasoning behind their selection, as well as the direction of future technology.
DTIC
Aircraft Engines; Particulates

12
ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

19980197315 NASA Langley Research Center, Hampton, VA USA
Framework for Small-Scale Experiments in Software Engineering: Guidance and Control Software Project: Software Engineering Case Study
Hayhurst, Kelly J., NASA Langley Research Center, USA; May 1998; 46p; In English
Contract(s)/Grant(s): RTOP 519-30-31-01
Report No.(s): NASA/TM-1998-207666; NAS 1.15:207666; L-17621; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Software is becoming increasingly significant in today's critical avionics systems. to achieve safe, reliable software, government regulatory agencies such as the Federal Aviation Administration (FAA) and the Department of Defense mandate the use of certain software development methods. However, little scientific evidence exists to show a correlation between software development methods and product quality. Given this lack of evidence, a series of experiments has been conducted to understand why and how software fails. The Guidance and Control Software (GCS) project is the latest in this series. The GCS project is a case study of the Requirements and Technical Concepts for Aviation RTCA/DO-178B guidelines, Software Considerations in Airborne Systems and Equipment Certification. All civil transport airframe and equipment vendors are expected to comply with these guidelines in building systems to be certified by the FAA for use in commercial aircraft. For the case study, two implementations of a guidance and control application were developed to comply with the DO-178B guidelines for Level A (critical) software. The development included the requirements, design, coding, verification, configuration management, and quality assurance processes. This paper discusses the details of the GCS project and presents the results of the case study.
Author
Software Engineering; Avionics; Airframes; Commercial Aircraft

19980197319 Louisiana State Univ., Mechanical Engineering Dept., Baton Rouge, LA USA
Dynamics of Large-Scale Structures for Jets in Crossflow ***Final Report***
Muldoon, Frank, Louisiana State Univ., USA; Acharya, Sumanta, Louisiana State Univ., USA; Mar. 1998; 27p; In English; 43rd; Gas Turbine and Aeroengine, 2-5 Jun. 1998, Stockholm, Sweden; Sponsored by American Society of Mechanical Engineers, USA; Original contains color illustrations
Contract(s)/Grant(s): NAG3-1641; RTOP 538-12-10
Report No.(s): NASA/CR-1998-206606; E-11125; NAS 1.26:206606; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Results of a three dimensional unsteady computational study of a row of jets injected normal to a cross-flow are presented with the aim of understanding the dynamics of the large scale structures in the region near the jet. The jet to cross-flow velocity ratio is .5. A modified version of the computer program (INS3D) which utilizes the method of artificial compressibility is used for the computations. Results obtained clearly indicate that the near field large scale structures are extremely dynamical in nature, and undergo bifurcation and reconnection processes. The dynamical near field structures identified include the counter rotating vortex pair (CVP), the horse-shoe vortex, wake vortex, wall vortex and the shear layer vortex. The dynamical features of these vortices are presented in this paper. The CVP is observed to be a convoluted structure interacting with the wall and horse-shoe vortices. The shear layer vortices are stripped by the crossflow, and undergo pairing and stretching events in the leeward side of the jet. The wall vortex is reoriented into the upright wake system. Comparison of the predictions with mean velocity measurements is made. Reasonable agreement is observed.
Author
Computational Fluid Dynamics; Gas Turbine Engines; Gas Turbines; Cross Flow; Dynamic Structural Analysis; Magnetic Field Reconnection; Wakes

19980200830 Defence Science and Technology Organisation, Airframes and Engines Div., Melbourne, Australia

Thermo-Mechanical Fatigue Life Prediction: A Critical Review

Zhuang, W. Z., Defence Science and Technology Organisation, Australia; Swansson, N. S., Defence Science and Technology Organisation, Australia; Jan. 1998; 35p; In English

Report No.(s): AD-A342720; DSTO-TR-0609; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Improved prediction methods for thermo-mechanical fatigue life will assist in reducing life cycle costs and increasing the availability of the hot section components in aircraft engines. Literature on thermo-mechanical fatigue life assessment is reviewed in this report, with an emphasis on the life prediction models applied in aircraft engines. Successful areas of application of these life prediction models are addressed as well as their limitations. Published quantitative thermo-mechanical fatigue life data for selected hot section materials is also summarized. The review concludes by indicating areas where knowledge is deficient and where further research would be most beneficial.

DTIC

Aircraft Engines; Engine Parts; Gas Turbine Engines; Fatigue Life; Performance Prediction; Thermal Fatigue; Thermodynamics

19980200842 Washington Univ., Materials Research Lab., Saint Louis, MO USA

High Temperature Environmental Test Facility for Uniaxial Testing under Cyclic Loading ***Final Report, 1 Aug. 1995 - 31 Jul. 1997***

Sastry, Shankar M., Washington Univ., USA; Jerina, K. L., Washington Univ., USA; Mar. 23, 1998; 20p; In English

Contract(s)/Grant(s): F49620-95-1-0407

Report No.(s): AD-A342711; AFRL-SR-BL-TR-98; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A versatile test facility is described for the measurement of tensile, compressive, fracture toughness, mechanical fatigue and thermomechanical fatigue properties of metals, intermetallics, ceramics, and composites at 25 to 200000 in vacuum, inert, and reducing atmospheres. The test system consists of a fully automated computer controlled axial load frame; a test chamber designed for interchangeable heating elements for different environments, grips for different types of loading and thermal histories, and ceramic rod extensometry. The facility overcomes a serious deficiency in test facilities and procedures to obtain material property data for the design of components subjected to high cycle fatigue loading conditions, thermomechanical fatigue, fatigue crack propagation in controlled atmospheres. The instrumentation fills the need to provide the designers with reliable and reproducible mechanical property data obtained under simulated loading conditions and operational environments. Damage tolerance concepts and predictive models that accurately reflect the combined effects of loading conditions and environmental species can be developed for qualification of mature and emerging high temperature materials for hypersonic high speed vehicle structures and advanced aircraft engines.

DTIC

Aircraft Engines; Cyclic Loads; Mechanical Properties; Crack Propagation; High Temperature Tests; Metal Fatigue; Refractory Materials; Thermal Fatigue

19980200909 Naval Postgraduate School, Monterey, CA USA

Theoretical Investigation of Rotor Acceleration Scheduling Through Critical Speed

Dec. 1997; 58p; In English

Report No.(s): AD-A342327; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

An analytical investigation was conducted to study the amplitude of lateral vibrations and vibrational energy and power of an unbalanced rotor passing through its first lateral bending critical speed. A two degree-of-freedom lumped mass, damping and stiffness model was developed to simulate the response of a simply supported, single disk rotor. Given an arbitrary input acceleration or deceleration, the equations of motion were solved numerically using a fourth order Runge-Kutta routine. The routine used a time step that corresponded to a constant angular phase of rotation The relationship between the forcing function and lateral vibrational velocity was determined in order to predict the instantaneous power input to the rotor due to the unbalanced rotor. The computer model incorporating an acceleration schedule yielded a result that predicts acceleration scheduling in the location about the critical speed is unable to lower the amplitude of lateral vibrations.

DTIC

Rotors; Angular Velocity; Scheduling; Degrees of Freedom; Equations of Motion; Computerized Simulation

19980200959 Vanderbilt Univ., Dept. of Physics and Astronomy, Nashville, TN USA

Probability of Detection in SQUID Nondestructive Evaluation ***Final Report, 30 Jun. 1994 - 31 Dec. 1997***

Wikswo, John P., Vanderbilt Univ., USA; Ewing, Anthony P., Vanderbilt Univ., USA; Apr. 21, 1998; 163p; In English

Contract(s)/Grant(s): F49620-94-1-0369; AF Proj. 3484
Report No.(s): AD-A342741; EML-1998-1; AFRL-SR-BL-TR-98-0365; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Superconducting Quantum Interference Device (SQUID) magnetometers are being used as tools for Nondestructive Evaluation (NDE) to detect and characterize defects in aging aircraft. to evaluate SQUID NDE reliability. a Probability of Detection (POD) analysis has been done. A Boundary Element Method (BEM) measurement model using a Green's function developed specifically for crack problems has been constructed for use in the POD analysis. The model simulates the 2-D images of the magnetic field obtained by scanning a SQUID magnetometer over a plate containing a crack and carrying an injected DC current. POD curves were generated through Monte Carlo simulation using distributions derived from sensitivity analyses and experimental noise measurements. For the conditions simulated, crack lengths of 1.4 mm (DC measurement) and 0.0134 mm (AC measurement) could be found with 90% probability of detection and 95% confidence. These small crack lengths suggest that additional experimental noise factors will have be incorporated into the POD analysis before realistic SQUID NDE capability can be accurately quantified.
DTIC
Nondestructive Tests; Squid (Detectors); Aircraft Structures; Aircraft Maintenance; Boundary Element Method; Magnetometers; Crack Propagation; Cracks

19980200983 NASA Marshall Space Flight Center, Huntsville, AL USA
Analysis of Flowfields over Four-Engine DC-X Rockets
Wang, Ten–See, NASA Marshall Space Flight Center, USA; Cornelison, Joni, NASA Marshall Space Flight Center, USA; Jounral of Spacecraft and Rockets; 1996; Volume 34, No. 5, pp. 620-627; In English; 32nd; Joint Propulsion Conference, 1-3 Jul. 1996, Lake Buena Vista, FL, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): NASA/TM-96-208088; NAS 1.15:208088; AIAA Paper 96-2953; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of this study is to validate a computational methodology for the aerodynamic performance of an advanced conical launch vehicle configuration. The computational methodology is based on a three-dimensional, viscous flow, pressure-based computational fluid dynamics formulation. Both wind-tunnel and ascent flight-test data are used for validation. Emphasis is placed on multiple-engine power-on effects. Computational characterization of the base drag in the critical subsonic regime is the focus of the validation effort; until recently, almost no multiple-engine data existed for a conical launch vehicle configuration. Parametric studies using high-order difference schemes are performed for the cold-flow tests, whereas grid studies are conducted for the flight tests. The computed vehicle axial force coefficients, forebody, aftbody, and base surface pressures compare favorably with those of tests. The results demonstrate that with adequate grid density and proper distribution, a high-order difference scheme, finite rate afterburning kinetics to model the plume chemistry, and a suitable turbulence model to describe separated flows, plume/air mixing, and boundary layers, computational fluid dynamics is a tool that can be used to predict the low-speed aerodynamic performance for rocket design and operations.
Author
Computer Programs; Procedures; Aerodynamic Characteristics; Conical Bodies; Launch Vehicle Configurations; Proving

19980200993 Cincinnati Univ., Dept. of Aerospace Engineering and Engineering Mechanics, OH USA
Development of an Experimental Data Base to Validate Compressor-Face Boundary Conditions Used in Unsteady Inlet Flow Computations ***Final Report, 1 Jan. - 31 Dec. 1997***
Sajben, Miklos, Cincinnati Univ., USA; Freund, Donald D., Cincinnati Univ., USA; May 15, 1998; 8p; In English
Contract(s)/Grant(s): NAG3-2007
Report No.(s): NASA/CR-1998-207987; NAS 1.26:207987; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The ability to predict the dynamics of integrated inlet/compressor systems is an important part of designing high-speed propulsion systems. The boundaries of the performance envelope are often defined by undesirable transient phenomena in the inlet (unstart, buzz, etc.) in response to disturbances originated either in the engine or in the atmosphere. Stability margins used to compensate for the inability to accurately predict such processes lead to weight and performance penalties, which translate into a reduction in vehicle range. The prediction of transients in an inlet/compressor system requires either the coupling of two complex, unsteady codes (one for the inlet and one for the engine) or else a reliable characterization of the inlet/compressor interface, by specifying a boundary condition. In the context of engineering development programs, only the second option is viable economically. Computations of unsteady inlet flows invariably rely on simple compressor-face boundary conditions (CFBC's). Currently, customary conditions include choked flow, constant static pressure, constant axial velocity, constant Mach number or constant mass flow per unit area. These conditions are straightforward extensions of practices that are valid for and work well with steady

inlet flows. Unfortunately, it is not at all likely that any flow property would stay constant during a complex system transient. At the start of this effort, no experimental observation existed that could be used to formulate of verify any of the CFBC'S. This lack of hard information represented a risk for a development program that has been recognized to be unacceptably large. The goal of the present effort was to generate such data. Disturbances reaching the compressor face in flight may have complex spatial structures and temporal histories. Small amplitude disturbances may be decomposed into acoustic, vorticity and entropy contributions that are uncoupled if the undisturbed flow is uniform. This study is focused on the response of an inlet/compressor system to acoustic disturbances. From the viewpoint of inlet computations, acoustic disturbances are clearly the most important, since they are the only ones capable of moving upstream. Convective and entropy disturbances may also produce upstream-moving acoustic waves, but such processes are outside the scope of the present study.
Author
Computational Fluid Dynamics; Inlet Flow; Unsteady Flow; Supersonic Compressors; Supersonic Inlets; Boundary Conditions

19980201096 Bell Helicopter Co., Fort Worth, TX USA
Operational Evaluation of a Health and Usage Monitoring System (HUMS) ***Final Report***
Cronkhite, J., Bell Helicopter Co., USA; Dickson, B., Bell Helicopter Co., USA; Martin, W., Bell Helicopter Co., USA; Collingwood, G., Bell Helicopter Co., USA; Apr. 1998; 58p; In English
Contract(s)/Grant(s): NAS2-14115; RTOP 581-30-13; DA Proj. 1L1-62211-A-47-A
Report No.(s): NASA/CR-1998-207409; NAS 1.26:207409; DOT/FAA/AR-97/64; ARL-CR-420; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report describes the results of a research program to evaluate structural usage monitoring and damage tolerance methodology using data collected concurrently during a helicopter flight program. The helicopter (a Bell Model 412 equipped with a Health and Usage Monitoring System (HUMS) and data recorder) was operated by Petroleum Helicopters Inc. (PHI) during the 1996 Summer Olympic Games in Atlanta, Georgia, under the FAA's Project HeliSTAR. The mission was referred to as the Atlanta Short Haul Mission (ASHM) and involved many short flights to provide pick up and delivery service at the Olympics. The usage data collected for the ASHM was used to perform fatigue life calculations and damage tolerance evaluations on selected rotor system components know as Principal Structural Elements (PSE's). The usage data from the ASHM were compared to certification data and to data from a previous study for a mission called the Gulf Coast Mission (GCM) which involved primarily long cruise flights. Although the usage was more severe for the ASHM than the GCM, the results of the comparison showed that usage monitoring would provide benefits in extending retirement times or inspection intervals, compared to certification, especially if high/low altitude effects were considered. In addition to usage monitoring evaluations, guidelines for HUMS certification are discussed along with potential economic benefits and simplified 'mini-HUMS' approaches to provide low cost systems with high paybacks.
Author
Diagnosis; Helicopters; Vibration Measurement; Rotors; Fatigue Life

19980201175 Colorado Univ., Dept. of Aerospace Engineering Sciences, Boulder, CO USA
High-Performance Parallel Analysis of Coupled Problems for Aircraft Propulsion ***Final Report, Jan. 1993 - Jul. 1996***
Felippa, C. A., Colorado Univ., USA; Farhat, C., Colorado Univ., USA; Park, K. C., Colorado Univ., USA; Gumaste, U., Colorado Univ., USA; Chen, P.–S., Colorado Univ., USA; Lesoinne, M., Colorado Univ., USA; Stern, P., Colorado Univ., USA; Sep. 1997; 126p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAG3-1425; RTOP 523-22-13
Report No.(s): NASA-CR-204148; E-10918; NAS 1.26:204148; CU-CAS-96-29; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Applications are described of high-performance computing methods to the numerical simulation of complete jet engines. The methodology focuses on the partitioned analysis of the interaction of the gas flow with a flexible structure and with the fluid mesh motion driven by structural displacements. The latter is treated by a ALE technique that models the fluid mesh motion as that of a fictitious mechanical network laid along the edges of near-field elements. New partitioned analysis procedures to treat this coupled three-component problem were developed. These procedures involved delayed corrections and subcycling, and have been successfully tested on several massively parallel computers, including the iPSC-860, Paragon XPIS and the IBM SP2. The NASA-sponsored ENG1O program was used for the global steady state analysis of the whole engine. This program uses a regular FV-multiblock-grid discretization in conjunction with circumferential averaging to include effects of blade forces, loss, combustor heat addition, blockage, bleeds and convective mixing. A load-balancing preprocessor for parallel versions of ENG1O was

developed as well as the capability for the first full 3D aeroelastic simulation of a multirow engine stage. This capability was tested on the IBM SP2 parallel supercomputer at NASA Ames.
Author
Parallel Processing (Computers); Aircraft Engines; Propulsion System Performance; Numerical Analysis; Computer Programs; Computerized Simulation

19980201197 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Optimizing the Efficiency of a Multi-Stage Axial-Flow Compressor: An Application of Stage-Wise Optimization
Miller, Shawn A., Air Force Inst. of Tech., USA; Mar. 1998; 94p; In English
Report No.(s): AD-A342229; AFIT/GOR/ENS/98M-17; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The development of jet engines has become an integral part of maintaining air superiority. In order to achieve the most advanced engine, research has turned to traditional optimization methods to aid in creating new engine designs. to develop simplified mathematical models representative of the engine, the engine can be separated into its components. A jet engine has three major elements, the compressor, combustion chamber and turbine. This research attempts to make an initial analysis of a two stage compressor to determine values of blade angles and spacing to chord ratios for both stages that produce the highest possible efficiency for the overall two stage compressor. A pitch line model is developed for a two stage compressor and is used in conjunction with a optimization method to solve for the on design air angles and spacing to chord ratios. The results of the model were compared to examples available in current literature to ensure the model properly represents a compressor stage. The off design performance of the results was calculated to determine how the designs for on design operated under off design conditions. Since practical compressors are made up of many stages, consideration is given to which optimization method would be most useful in solving for a multistage compressor.
DTIC
Turbofan Engines; Turbocompressors; Engine Design; Engine Parts; Compressor Efficiency

19980201247 NASA Dryden Flight Research Center, Edwards, CA USA
Thermal Analysis of a Metallic Wing Glove for a Mach-8 Boundary-Layer Experiment
Gong, Leslie, NASA Dryden Flight Research Center, USA; Richards, W. Lance, NASA Dryden Flight Research Center, USA; Jun. 1998; 18p; In English; 7th; Thermophysics and Heat Transfer, 15-18 Jun. 1998, Albuquerque, NM, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 529-60-24-00-17
Report No.(s): NASA/TM-1998-206555; H-2259; NAS 1.15:206555; AIAA Paper 98-2580; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A metallic 'glove' structure has been built and attached to the wing of the Pegasus(trademark) space booster. An experiment on the upper surface of the glove has been designed to help validate boundary-layer stability codes in a free-flight environment. Three-dimensional thermal analyses have been performed to ensure that the glove structure design would be within allowable temperature limits in the experiment test section of the upper skin of the glove. Temperature results obtained from the design-case analysis show a peak temperature at the leading edge of 490 F. For the upper surface of the glove, approximately 3 in. back from the leading edge, temperature calculations indicate transition occurs at approximately 45 sec into the flight profile. A worst-case heating analysis has also been performed to ensure that the glove structure would not have any detrimental effects on the primary objective of the Pegasus a launch. A peak temperature of 805 F has been calculated on the leading edge of the glove structure. The temperatures predicted from the design case are well within the temperature limits of the glove structure, and the worst-case heating analysis temperature results are acceptable for the mission objectives.
Author
Aerodynamic Heating; Boundary Layer Transition; Finite Element Method; Thermal Analysis; Hypersonic Speed; Design Analysis

19980201334 NASA Lewis Research Center, Cleveland, OH USA
Advanced Seal Technology Role in Meeting Next Generation Turbine Engine Goals
Steinetz, Bruce M., NASA Lewis Research Center, USA; Hendricks, Robert C., NASA Lewis Research Center, USA; Munson, John, Allison Engine Co., USA; Apr. 1998; 14p; In English; 1st; Propulsion and Power Systems First Meeting: Design Principles and Methods for Aircraft Gas Turbine Engines, 11-15 May 1998, Toulouse, France; Sponsored by North Atlantic Treaty Organization, Belgium
Contract(s)/Grant(s): RTOP 538-12-20

Report No.(s): NASA/TM-1998-206961; NAS 1.15:206961; AVT-PPS Paper-11; E-11109; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Cycle studies have shown the benefits of increasing engine pressure ratios and cycle temperatures to decrease engine weight and improve performance in next generation turbine engines. Advanced seals have been identified as critical in meeting engine goals for specific fuel consumption, thrust-to-weight, emissions, durability and operating costs. NASA and the industry are identifying and developing engine and sealing technologies that will result in dramatic improvements and address the goals for engines entering service in the 2005-2007 time frame. This paper provides an overview of advanced seal technology requirements and highlights the results of a preliminary design effort to implement advanced seals into a regional aircraft turbine engine. This study examines in great detail the benefits of applying advanced seals in the high pressure turbine region of the engine. Low leakage film-riding seals can cut in half the estimated 4% cycle air currently used to purge the high pressure turbine cavities. These savings can be applied in one of several ways. Holding rotor inlet temperature (RM constant the engine specific fuel consumption can be reduced 0.9%, or thrust could be increased 2.5%, or mission fuel burn could be reduced 1.3%. Alternatively, RIT could be lowered 20 'F resulting in a 50% increase in turbine blade life reducing overall regional aircraft maintenance and fuel burn direct operating costs by nearly 1%. Thermal, structural, secondary-air systems, safety (seal failure and effect), and emissions analyses have shown the proposed design is feasible.

Author

Seals (Stoppers); Design Analysis; Turbine Engines; Thrust-Weight Ratio; Inlet Temperature; Gas Turbine Engines; Fuel Consumption; Aircraft Maintenance; Aircraft Engines

19980201496 Tuskegee Inst., Dept. of Mechanical Engineering, AL USA

Characterization of Flow Behind The Fan of a Turbofan Engine

Sree, Dave, Tuskegee Inst., USA; HBCUs Research Conference Agenda and Abstracts; Apr. 1998, pp. 46; In English; Also announced as 19980201458; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche; Abstract Only; Abstract Only

A three-year research grant was awarded to Tuskegee University by NASA Lewis Research Center (LeRC) to perform research on characterizing the fan wake flows of turbofan engines. Emphasis is placed on determining how the fan wake flow contributes to the noise produced by the engine. Experimental (hot-wire) data obtained downstream of the fans of two different engine models have been supplied by LeRC. FORTRAN codes have been developed to perform the data analysis. Typical results obtained from the data analysis include estimates of mean and turbulent velocities, autocorrelation, autospectra, two-point correlation, wave number frequency spectra, and integral time scales at various locations downstream of the fan. The results of the analysis may provide insights as to how the fan blades and/or stator vanes might be redesigned so that the engine model generates less noise. Furthermore, the results can be used to calibrate codes developed to predict the flow field, and as input to codes developed to predict the noise generated by the engine model.

Author

Turbofan Engines; Fan Blades; FORTRAN; Engine Noise; Propeller Noise; Noise Reduction; Mathematical Models; Turbulent Wakes

19980201771 Galaxy Scientific Corp., Egg Harbor Township, NJ USA

Heating Comparison of Radial and Bias-Ply Tires on a B-727 Aircraft

Cavage, William M., Galaxy Scientific Corp., USA; Nov. 1997; 19p; In English

Contract(s)/Grant(s): DTFA03-92-D-00035

Report No.(s): AD-A340420; DOT/FAA/AR-TN97/50; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Aircraft taxi tests were conducted to compare the heating correlation of radial and bias-ply tires. The tires were tested on a Boeing 727-200QC, owned and operated by the Federal Aviation Administration (FAA) for the purpose of aircraft safety research. The aircraft was taxied at two different tire loads, at three different speeds, and for a given distance unless a threshold temperature of 250 F was reached. There was also a 14-mile roll test of 25 mph and a 31,000 pound tire load was conducted to make a comparison between the radial and bias-ply tire heating. The differences in temperature change (AT) between the radial and the bias-ply tires that were taxied the same distance and tire load were then compared. In summary, the radial tire ran cooler in all scenarios of weight and taxi speed. Bead temperatures were from 5 to 20 percent less for the radial tire than for the bias-ply tire. Tire load had a significant affect on tire heating. A 24 percent increase in weight caused a 17 percent increase in tire temperature over a distance of 36,000 feet for the bias-ply tire and an 8.5 percent increase for the radial tire under the same conditions. Taxi speed affected the change in bead temperature but only after a certain distance was taxied.

DTIC

Heating; Bias; Dynamic Tests; Aircraft Safety

13
GEOSCIENCES

Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

19980201752 Vista Research Corp., Mountain View, CA USA

Robust Analysis of Aerothermal Data

Papanicolaou, G., Vista Research Corp., USA; Solna, K., Vista Research Corp., USA; Rino, C., Vista Research Corp., USA; Kruger, V., Vista Research Corp., USA; Feb. 17, 1998; 64p; In English

Contract(s)/Grant(s): F49620-97-C-0018

Report No.(s): AD-A340259; TR-2096; AFRL-SR-BL-TR-98-0271; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The main premise driving our analysis of temperature data from a turbulent atmosphere is that it is a local power law process. This means that the power law itself the power (slope) and the multiplicative constant (log intercept) is not a constant but a slowly varying function, deterministic or random. We estimate the slope and log intercept of the scale spectrum by appropriately segmenting the data and then removing segmentation effects by a filtering process. An important aspect of the model that we use is separation of scales in the variation of the estimate parameters (slope and log intercept) from the underlying process that generates the power law spectra. This will be the starting point for a detailed theoretical development of the methods that we have introduced here. DTIC

Aerothermodynamics; Turbulence

19980201755 Metrica, Inc., San Antonio, TX USA

The Use of Weather Information in Aeronautical Decision-Making, 2 ***Final Report***

Driskill, Walter E., Civil Aeromedical Inst., USA; Weissmuller, Johnny J., Civil Aeromedical Inst., USA; Quebe, John C., Civil Aeromedical Inst., USA; Hand, Darryl K., Civil Aeromedical Inst., USA; Hunter, David R., Federal Aviation Administration, USA; Nov. 1997; 56p; In English

Report No.(s): AD-A340406; DOT/FAA/AM-97/23; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

An investigation was conducted of the values, or worth functions, pilots attribute to weather and terrain variables in making decisions about flight in a single engine aircraft under visual flight rules. This study replicated earlier exploratory research (Driskill, Weissmuller, Quebe, Hand, Dittmar, and Hunter, 1997) that used data from a single geographic area. The present study obtained data from pilots in six geographic regions of the USA. The results of this study confirm the three tentative hypotheses suggested by the data from the initial study: (1) Cognitive processes that pilots utilize in making aeronautical decisions can be modeled using regression methods; (2) The values pilots associate with varying levels of ceiling, visibility, and precipitation are a function of the terrain over which the flight is made; and (3) While values differ among pilots, specific policies can be found to describe how they assign weights in making decisions about beginning or continuing a flight. Generally, pilots use a compensatory decision strategy, combining the weather variables in making judgments about flight by compensating for poor conditions in one variable with better conditions in other variables. However, under some circumstances, pilots also tend to employ a worst factor strategy; that is, pilots appear to have personal standards for either ceiling, visibility, or precipitation, below which they become reluctant to make a flight. DTIC

Decision Making; Data Acquisition; Experimentation; Flight Safety; Weather

14
LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

19980197299 NASA Johnson Space Center, Houston, TX USA

Multimodal Perception and Multicriterion Control of Nested Systems, 2, Constraints on Crew Members During Space Vehicle Abort, Entry, and Landing

Riccio, Gary E., Nascent Technologies Ltd., USA; McDonald, P. Vernon, Wyle Labs., Inc., USA; Irvin, Gregg E., Nascent Technologies Ltd., USA; Bloomberg, Jacob J., NASA Johnson Space Center, USA; Apr. 1998; 40p; In English

Report No.(s): NASA-TP-1998-3703; NAS 1.60:3703; S-835; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report reviews the operational demands made of a Shuttle pilot or commander within the context of a proven empirical methodology for describing human sensorimotor performance and whole-body coordination in mechanically and perceptually complex environments. The conclusions of this review pertain to a) methods for improving our understanding of the psychophysics and biomechanics of visual/manual control and whole-body coordination in space vehicle cockpits; b) the application of scientific knowledge about human perception and performance in dynamic inertial conditions to the development of technology, procedures, and training for personnel in space vehicle cockpits; c) recommendations for mitigation of safety and reliability concerns about human performance in space vehicle cockpits; and d) in-flight evaluation of flight crew performance during nominal and off-nominal launch and reentry scenarios.
Author (revised)
Visual Control; Human Performance; Biodynamics; Cockpits; Flight Crews

19980200926 Washington Univ., Human Interface Technology Lab., Seattle, WA USA
Communicating Situation Awareness in Virtual Environments ***Final Report, 15 May 1993 - 31 Sep. 1997***
Wells, Maxwell J., Washington Univ., USA; Apr. 1998; 47p; In English
Contract(s)/Grant(s): F49620-93-1-0339; AF Proj. 3484
Report No.(s): AD-A342567; AFRL-SR-BL-TR-98-0395; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report documents the work conducted by the HIT Lab during a four year project titled Communicating Situation Awareness in Virtual Environments. The project was funded under the MURI (Multi-disciplinary University Research Initiative), and was intended as spin up funding to allow the Lab to achieve critical mass and momentum. As such, the goals of both the fund providers and fund recipients were successfully achieved. Over the course of the project over 30 experiments were conducted resulting in 76 publications. Support was provided for approximately 20 students, resulting in 9 theses and dissertations. A multidisciplinary workshop was conducted, and there were active collaborations between researchers in this lab, with other labs, with government agencies and with commercial companies. The benefits of this collaboration are beginning to take effect. The focus of the research effort was tightened during the last year of the project to address five key areas. The results from experiments investigating four of these five areas are presented in this report, along with a cumulative list of all of the publications.
DTIC
Human Factors Engineering; Flight Simulators; Virtual Reality; Environment Simulation

19980201107 Army Aeromedical Research Lab., Fort Rucker, AL USA
Effects of Seat Stroke Distance on the Allowable Mass of Head Supported Devices ***Final Report***
Mobasher, Amir A., UES, Inc., USA; Brozoski, Frederick T., UES, Inc., USA; McEntire, B. J., Army Aeromedical Research Lab., USA; Alem, Nabih M., Army Aeromedical Research Lab., USA; Apr. 1998; 16p; In English
Contract(s)/Grant(s): DA Proj. 301-62787-A-878
Report No.(s): AD-A342941; USAARL-98-26; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The effects of stroking distance of energy attenuating helicopter seat on head supported device (HSD) masses were investigated in various helicopter crash scenarios. The Articulated Total Body (ATB) model was used to simulate the helicopter pilot's biodynamic response to five different crash pulses. Parameters of the simulations included two allowable seat stroking distances (2.5 and 25 cm) and four HSD masses (0.45, 1.4, 2.7, and 4.1 kg). The simulations were performed with the mid-sized Hybrid III manikin as the occupant model, and the HSD center of mass (CM) coincident with the CM of the Hybrid III head. Moments and forces produced by the ATB simulations at the head/neck interface (occipital condyles) were assessed against injury thresholds to determine the risk of neck injury. Acceptable head supported masses were established then for the given impact conditions. The report concludes that acceptable HSD mass was highly dependant on seat stroke distance and impact conditions, which include crash pulse magnitude, direction and shape. For a Hybrid III dummy, increased available seat strokes resulted in lower loads transmitted to the head/neck interface, thereby allowing larger HSD masses to be worn.
DTIC
Human Factors Engineering; Helicopters; Accidents; Seats; Injuries; Biodynamics

19980201205 Cincinnati Univ., OH USA
Female Reproductive Effects of Exposure to Jet Fuel at U.S. Air Force Bases ***Annual Report, 15 Oct. 1996 - 14 Oct. 1997***
Lemasters, Grace K., Cincinnati Univ., USA; Nov. 1997; 66p; In English
Contract(s)/Grant(s): DAMD17-96-2-6015
Report No.(s): AD-A338804; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
One of the prevalent exposures at all Air Force (AF) bases is to jet fuel. Total consumption ranks in the billions of gallons. Jet fuel is composed of aliphatic/aromatic hydrocarbons and traces of metals that have potential adverse effects on health including

menstrual disorders infertility, spontaneous abortions, and fetal effects. The mean age of active enlisted female Air Force personnel is 27.6 This study addresses whether or not women are experiencing menstrual systems related to their work place from fuel exposures. This study evaluates environments and internal dose measurements of jet fuel components during the course of each woman 5 usual work activities.
DTIC
Armed Forces (USA); Females; Health; Jet Engine Fuels

19980201280 Ohio State Univ., Columbus, OH USA
An Evaluation of Pilot Acceptance of the Personal Minimums Training Program for Risk Management ***Final Report***
Jensen, Richard S., Ohio State Univ., USA; Guilkey, James E., Ohio State Univ., USA; Hunter, David R., Federal Aviation Administration, USA; Feb. 1998; 22p; In English
Report No.(s): AD-A340338; DOT/FAA/AM-98/6; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A new general aviation training program entitled, 'Personal Minimums for Aviator Risk Management in Pre Take off Decisions' was field tested in five diverse geographic locations around the USA (Columbus, OH; Long Beach, CA; Anchorage, AL; Baltimore, MD/Washington, DC; and Chicago, IL) to determine its acceptability to pilot audiences and to obtain feedback for further development of the intervention. In each case, following the presentation, participants were asked to evaluate the course and its acceptability to the general aviation community. Analysis of these evaluations revealed that respondents viewed the training program as helpful and intended to use personal minimums as part of their pre flight decision making in the future. Respondent comments and feedback from local FAA personnel at each of the field sites resulted in progressive modifications to the training format and presentation to improve its acceptance and utility throughout the course of the field test. It is recommended that development proceed with video and computer based versions of this training program and that studies of the training impact be conducted, possibly in concert with the dissemination of the program throughout the FAA safety seminar program.
DTIC
Flight Training; General Aviation Aircraft; Aircraft Pilots; Decision Making

19980201293 Army Aeromedical Research Lab., Fort Rucker, AL USA
The Effect of Exposure to the AH -64 Combat Mission Flight Simulator On Postural Equilibrium ***Final Report***
Braithwaite, Malcolm G., Army Aeromedical Research Lab., USA; Manning, Julius C., Army Aeromedical Research Lab., USA; Groh, Shannon L., Army Aeromedical Research Lab., USA; Jan. 1998; 23p; In English
Contract(s)/Grant(s): 3M162787A879
Report No.(s): AD-A339573; USAARL-98-15; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Simulator sickness syndrome is a form of motion sickness that may occur during the simulator training exercise, immediately after, or sometime later. It may be induced by either physical or visual motion, and symptoms include: nausea, disorientation, ataxia, dizziness, visual problems, headache, depression, and sweating. An important operational problem associated with simulator sickness is the extent to which an individual aviator is incapacitated. This will determine how long after simulator exposure the aviator needs to be grounded. Previous researchers have measured postural equilibrium with standing and walking tests, but there are limitations associated with these tests. A modern method of objective measurement is the Neurocom Pro Balance Master. The purpose of this assessment was to determine the effect of exposure to the AH-64 Combat Mission Simulator (CMS) on postural equilibrium. Six instructor pilots, 42 male student pilots, and 3 female student pilots were tested. The results clearly suggested that student training in the AH-E4 CMS in its present configuration has an insignificant effect on postural equilibrium. A 2-hour period of "grounding" between training in the flight simulator and actual flight is probably adequate. Further assessments should be conducted in field locations.
DTIC
Flight Training; Signs and Symptoms; Flight Simulators; Motion Sickness

19980201427 South Carolina Univ., Columbia, SC USA
Effect of an Airplane Cabin Water Spray System on Human Thermal Behavior: A Theoretical Study Using a 25-Node Model of Thermoregulation
Wolf, Matthew B., South Carolina Univ., USA; Garner, Robert P., South Carolina Univ., USA; Feb. 1998; 22p; In English
Report No.(s): AD-A339365; DOT/FAA/AM-98/4; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This study was conducted to assess the effect of an aircraft cabin water spray system on thermoregulatory responses of passengers after being wetted by the spray system. A mathematical model was developed that could adequately describe experimentally determined transient changes in metabolic rate (MR), and core and skin temperatures of human beings exposed to water-immersion conditions (0 to 280C). The model was the basic 25-node description of Stolwijk and Hardy as modified to apply to a male

with medium fat content. The MR increase induced by shivering was described by 3 components sensitive to 1) time-rate of change of skin temperature, 2) the product of changes in skin and head-core temperatures and 3) the product of skin temperature change and the time-rate of change of head-core temperature. The model was also able to closely predict the changes in MR and skin temperatures induced by exposure to cold air. However, the predictions of rectal temperature changes were in the opposite direction to the experimental data for this case. The model was modified to describe the effects of spraying individuals with water on their heads, arms and torsos to simulate the action of a cabin water spray system activated by a fire in an airplane. The model predicted that an individual, after being sprayed and exiting into a cold and windy environment, would encounter only a minor increase in thermal stress compared to the dry state. We conclude that mathematical simulation is an effective method of predicting thermal behavior of humans under a variety of cold conditions.
DTIC
Temperature Control; Aircraft Compartments; Thermoregulation

19980201431 Armstrong Lab., Crew Systems Directorate, Wright-Patterson AFB, OH USA
EValuation of A Proposed B-2 Seat Cushion by + Gz Impact ***Interim Report***
Perry, Chris E., Armstrong Lab., USA; Feb. 1997; 121p; In English
Contract(s)/Grant(s): AF Proj. 7184
Report No.(s): AD-A339408; AL/CF-TR-1997-0112; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Optimal seat comfort is required for aircrew operational effectiveness in all USAF aircraft. Extended missions in ejection seat aircraft must balance comfort with the cushion's influence on the risk of vertebral fracture during ejection. McDonnell Douglas and Northrop Grumman recently designed a proposed seat cushion for the ACES 2 ejection seat in the B-2 aircraft to improve sitting comfort. The Escape and Impact Protection Branch was requested by the San Antonio Air Logistics Center to evaluate potential spinal injury risk with the proposed cushion. A series of vertical impact tests were conducted with volunteer human subjects to compare the impact response of the proposed cushion to a 'no cushion' impact condition, and to the existing B-2 ACES 2 seat cushion. All tests were conducted on the Armstrong Laboratory's Vertical Deceleratio Tower using a +Gz peek impact of 100. Test results indicate that the human impact response with the proposed B-2 ACES 2 seat cushion is not significantly different from the response with no seat cushion or with the current B-2 ACES 2 seat cushion. This indicates that the current risk of spinal injury would not increase with the proposed cushion within the limits evaluated.
DTIC
Ejection Seats; B-2 Aircraft

19980201750 Civil Aeromedical Inst., Office of Aviation Medicine, Oklahoma City, OK USA
Automation in General Aviation: Two Studies of Pilot Responses to Autopilot Malfunctions ***Final Report***
Beringer, Dennis B., Civil Aeromedical Inst., USA; Harris, Howard C., jr, Civil Aeromedical Inst., USA; Dec. 1997; 26p; In English
Report No.(s): AD-A340243; DOT/FAA/AM-97/24; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Study 1 examined four automation related malfunctions (runaway pitch trim up, roll servo failure, roll sensor failure, pitch drift up) and subsequent pilot responses. Study 2 examined four additional malfunctions; two more immediately obvious (runaway pitch trim down, runaway roll servo) and two subtler (failed attitude indicator, pitch sensor drift down) than those in Study 1, and the effect of an auditory warning. Data collection was performed in the Civil Aeromedical Institute's Advanced General Aviation Research Simulator, configured as a Piper Malibu. Results suggest that maladaptive responses to some of these failures may, in a significant percentage of cases, lead to significant altitude loss, overstress of the airframe, disorientation of the pilot, or destruction of the aircraft. Percentages of successful recoveries, detection/correction times, and related indices of performance are discussed in the context of malfunction type, flight profile, and auditory alerts.
DTIC
Automatic Pilots; Airframes; Attitude Indicators; General Aviation Aircraft; Servomechanisms

19980201800 Army Aeromedical Research Lab., Fort Rucker, AL USA
Visor Use Among U.S. Army Rotary-Wing Aviators ***Final Report***
Rash, Clarence E., Army Aeromedical Research Lab., USA; Mora, John C., Army Aeromedical Research Lab., USA; Ledford, Melissa H., Army Aeromedical Research Lab., USA; Reynolds, Barbara S., Army Aeromedical Research Lab., USA; Ivey, Rebecca H., Army Aeromedical Research Lab., USA; Jan. 1998; 73p; In English
Contract(s)/Grant(s): 3O162787A879
Report No.(s): AD-A340128; USAARL-98-16; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Visors are optical devices that provide a level of comfort and protection from dust, wind, sun glare and particle fragments and, in the case of a crash, from tree branches, rocks, debris and aircraft structural parts. This report presents the results of a survey whose objective was to document visor usage, and identify problems associated with optical quality, and maintenance in Army rotary wing aviation. The survey was distributed to U.S. Army aviators and crewmen at Fort Hood, Texas; Fort Rucker, Alabama; Fort Campbell, Kentucky; and Fort Bragg, North Carolina. The survey identified that guidelines for visor use need to be established. Minor problems with haze, distortion, luminous transmittance, and prismatic deviation were also identified. Other problems include' mechanical difficulties, e.g., visors sticking and coming off track, inadequate custom trimming for IHADSS visors, and ANVIS incompatibility. Data support that dual visor design results in higher percentage of visor use.
DTIC
Optical Equipment; Visors; Surveys; Crashes; Protection; Aircraft Structures

19980201805 Federal Aviation Administration, William J. Hughes Technical Center, Atlantic City, NJ USA
Effect of Free Flight Conditions on Controller Performance, Workload, and Situation Awareness
Endsley, Mica R., Federal Aviation Administration, USA; Mogford, Richard H., Federal Aviation Administration, USA; Allendoerfer, Kenneth R., Federal Aviation Administration, USA; Snyder, Michael D., Federal Aviation Administration, USA; Stein, Earl S., Federal Aviation Administration, USA; Dec. 1997; 53p; In English
Report No.(s): AD-A340228; DOT/FAA/CT-TN97/12; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Free flight represents a major change in the way that aircraft are handled in the National Airspace System. It has the potential to significantly increase airspace utilization and, by doing so, improve aircraft throughput. The degree to which these objectives can be met without compromising aircraft safety will depend on appropriate changes in the air traffic control system. This study provides an evaluation of some of the potential effects of free flight on controllers' ability to maintain an accurate and complete picture of the traffic situation. This picture or mental representation is essential for monitoring and separation functions. The study revealed that, using current technology, some aspects of free flight may adversely influence the situation awareness and performance of controllers. The results provide information on some possible consequences of free flight that should be explored in future research.
DTIC
Workloads (Psychophysiology); National Airspace System; Free Flight; Flight Control; Flight Conditions; Aircraft Safety

15
MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

19980197325 NASA Langley Research Center, Hampton, VA USA
Streamlining Software Aspects of Certification: Technical Team Report on the First Industry Workshop
Hayhurst, Kelly J., NASA Langley Research Center, USA; Holloway, C. Michael, NASA Langley Research Center, USA; Knight, John C., Virginia Univ., USA; Leveson, Nancy G., Washington Univ., USA; Yang, Jeffrey C., Mitre Corp., USA; Dorsey, Cheryl A., Digital Flight, USA; McCormick, G. Frank, Certification Services, Inc., USA; Apr. 1998; 58p; In English
Contract(s)/Grant(s): RTOP 505-64-10-58
Report No.(s): NASA/TM-1998-207648; NAS 1.15:207648; L-17716; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

To address concerns about time and expense associated with software aspects of certification, the Federal Aviation Administration (FAA) began the Streamlining Software Aspects of Certification (SSAC) program. As part of this program, a Technical Team was established to determine whether the cost and time associated with certifying aircraft can be reduced while maintaining or improving safety, with the intent of impacting the FAA's Flight 2000 program. The Technical Team conducted a workshop to gain a better understanding of the major concerns in industry about software cost and schedule. Over 120 people attended the workshop, including representatives from the FAA,commercial transport and general aviation aircraft manufacturers and suppliers, and procurers and developers of non-airborne systems; and, more than 200 issues about software aspects of certification were recorded. This paper provides an overview of the SSAC program, motivation for the workshop, details of the workshop activities and outcomes, and recommendations for follow-on work.
Author
Transport Aircraft; Computer Programs; Certification; General Aviation Aircraft

19980200964 Washington Univ., Dept. of Systems Science and Mathematics, Saint Louis, MO USA

Nonlinear Control Systems ***Final Report, 1 Mar. 1995 - 28 Feb. 1998***

Byrnes, Christopher I., Washington Univ., USA; Isidori, Alberto, Washington Univ., USA; Feb. 28, 1998; 67p; In English

Contract(s)/Grant(s): F49620-95-1-0232

Report No.(s): AD-A342728; SSM-59114; AFRL-SR-BL-TR-98-0355; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The principal goal of this three years research effort was to enhance the research base which would support efforts to systematically control, or take advantage of, dominant nonlinear or distributed parameter effects in the evolution of complex dynamical systems. Such an enhancement is intended to support the development of flight controllers for increasing the high angle of attack or high agility capabilities of existing and future generations of aircraft and missiles. The principal investigating team has succeeded in the development of a systematic methodology for designing feedback control laws solving the problems of asymptotic tracking and disturbance rejection for nonlinear systems with unknown, or uncertain, real parameters. Another successful research project was the development of a systematic feedback design theory for solving the problems of asymptotic tracking and disturbance rejection for linear distributed parameter systems. The technical details which needed to be overcome are discussed more fully in this final report.

DTIC

Nonlinear Systems; Control Theory; Distributed Parameter Systems; Feedback Control; Flight Control; Missiles; Complex Systems

19980201045 NASA Marshall Space Flight Center, Huntsville, AL USA

Preliminary In-Flight Loads Analysis of In-Line Launch Vehicles using the VLOADS 1.4 Program

Graham, J. B., NASA Marshall Space Flight Center, USA; Luz, P. L., NASA Marshall Space Flight Center, USA; Jun. 1998; 44p; In English

Report No.(s): NASA/TM-1998-208472; NAS 1.15:208472; M-873; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

To calculate structural loads of in-line launch vehicles for preliminary design, a very useful computer program is VLOADS 1.4. This software may also be used to calculate structural loads for upper stages and planetary transfer vehicles. Launch vehicle inputs such as aerodynamic coefficients, mass properties, propellants, engine thrusts, and performance data are compiled and analyzed by VLOADS to produce distributed shear loads, bending moments, axial forces, and vehicle line loads as a function of X-station along the vehicle's length. Interface loads, if any, and translational accelerations are also computed. The major strength of the software is that it enables quick turnaround analysis of structural loads for launch vehicles during the preliminary design stage of its development. This represents a significant improvement over the alternative-the time-consuming, and expensive chore of developing finite element models. VLOADS was developed as a Visual BASIC macro in a Microsoft Excel 5.0 work book on a Macintosh. VLOADS has also been implemented on a PC computer using Microsoft Excel 7.0a for Windows 95. VLOADS was developed in 1996, and the current version was released to COSMIC, NASA's Software Technology Transfer Center, in 1997. The program is a copyrighted work with all copyright vested in NASA.

Author

Launch Vehicles; Computer Programs; Aerodynamic Loads; Applications Programs (Computers); Finite Element Method; Thrust

19980201692 Academy of Sciences (USSR), Keldysh Inst. of Applied Mathematics, Moscow, USSR

Reentry algorithm for rescue reentry vehicle

Sikharoulidze, Y. G., Academy of Sciences (USSR), USSR; Kaluzhskikh, Y. N., Academy of Sciences (USSR), USSR; AAS/GSFC 13th International Symposium on Space Flight Dynamics; May 1998; Volume 2, pp. 715-726; In English; Also announced as 19980201678

Report No.(s): AAS Paper 98-360; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The paper discusses the main principles of a reentry algorithm for a rescue reentry vehicle with the average lift-to-drag ratio (about 0.5). The rescue reentry vehicle must realize a mission in a short time. So the reentry algorithm must provide a high accuracy (about 1 km) that allows to use not 1...2 landing places, but one order more. A high activity of mission assumes the autonomous reentry guidance including a solution of two-point boundary problem on a choice of a reference (command) roll angle function. The reference roll angle function is a piece wise constant with three roll overturns. This allows to reduce to zero downrange miss and cross-range miss simultaneously. The developed method permits quickly to obtain a solution within the guaranteed zone of vehicle maneuver. It is possible also to take into account a limitation on a maximal value of a load factor that is important for a

rescue reentry vehicle. The mathematical simulation of a reentry in the disturbed atmosphere for different location of a landing point confirms a high accuracy of the developed algorithm.
Author
Reentry Vehicles; Rescue Operations; Reentry Guidance; Algorithms; Boundary Value Problems; Spacecraft Reentry; Aerodynamics

19980201759 Assurance Technology Corp., Carlisle, MA USA
Design and Development of the Generic Controller Assembly ***Final Report, 17 Aug. 1990 - 10 Nov. 1997***
Farar, Milton V., Assurance Technology Corp., USA; Graham, William, Assurance Technology Corp., USA; Nov. 10, 1997; 62p; In English
Contract(s)/Grant(s): F19628-90-C-0138; AF Proj. 2822
Report No.(s): AD-A339898; Rept-5922-100; PL-TR-97-2139; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This contract had as its goal to develop a generic controller capability that could be adapted to any system the USAF chooses to fly in space. During its development, a need arose for controllers to support two USAF space flights, a Shuttle based Charged Analysis and Wake Studies (CHAWS) system and a satellite-based Flight Model Discharge System (FMDS). The generic nature of the hardware and software under development simplified the task of providing 'generic controller' systems that could readily support the two very diverse programs. This report gives the details of the hardware and software of the controller and supporting test equipment for the two missions. It shows that it sufficient capability is built into a controller for a complex mission, then other simpler missions need only be a subset of the original controller hardware and software. Both controller flight units supported their respected missions flawlessly.
DTIC
Controllers; Systems Engineering; Adaptive Control; Telemetry; Computer Programs; Flight Control

18
SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radation.

19980201238 NASA Langley Research Center, Hampton, VA USA
Atmospheric Ionizing Radiation (AIR) ER-2 Preflight Analysis
Tai, Hsiang, NASA Langley Research Center, USA; Wilson, John W., NASA Langley Research Center, USA; Maiden, D. L., NASA Langley Research Center, USA; Jun. 1998; 28p; In English
Contract(s)/Grant(s): RTOP 537-09-21-23
Report No.(s): NASA/TP-1998-208422; NAS 1.60:208422; L-17648; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Atmospheric ionizing radiation (AIR) produces chemically active radicals in biological tissues that alter the cell function or result in cell death. The AIR ER-2 flight measurements will enable scientists to study the radiation risk associated with the high-altitude operation of a commercial supersonic transport. The ER-2 radiation measurement flights will follow predetermined, carefully chosen courses to provide an appropriate database matrix which will enable the evaluation of predictive modeling techniques. Explicit scientific results such as dose rate, dose equivalent rate, magnetic cutoff, neutron flux, and air ionization rate associated with those flights are predicted by using the AIR model. Through these flight experiments, we will further increase our knowledge and understanding of the AIR environment and our ability to assess the risk from the associated hazard.
Author
Radiation Measurement; Supersonic Transports; Prediction Analysis Techniques; Ionizing Radiation; Atmospheric Radiation

Subject Term Index

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